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STUDY ON THE APPLICABILITY OF PEPPER (PIPERINE) IN PHARMACEUTICAL PRODUCTS

XP/INT/95/066

Technical report: Findings and recommendations*

Prepared for the International Pepper Community
by the United Nations Industrial Development Organization

Based on the work of G.K. Warrier,
consultant in technological/market studies

Backstopping officer: T. De Silva
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* Mention of company names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO). This document has not been edited.

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EXECUTIVE SUMMARY

Although the most profitable market for Piper nigrum at present is the food/flavour industry, forms of black and white pepper are utilised in pesticides, cosmetics and pharmaceuticals products. Traditional medical systems all over the world have made use of its healing properties for many centuries, and today western scientists are testing it for its effects upon the human body so that new medicines which include pepper may well be invented in the next ten years to treat illnesses.

Summaries of the pharmacological and database research and scientific literature, etc., included in this report may be found in relevant sections noted in the Table of Contents.

Total world utilisation of black pepper in registered herbal and pharmaceutical products is probably no more than 40-50 tonnes at present with major markets in the West being the United States and Europe, of which Germany is the largest consumer. There are no signs of significant growth in volume. It is likely that the most growth in utilisation of pepper in pharmaceutical products will occur in India and the Far East, specifically Korea in the short term and India and China in the longer term. However, through active, coordinated promotion of the positive uses of pepper, a stronger market could be developed for it. Another approach would be to investigate compounds which can be derived from pepper and to develop markets for useful pharmacologically-active substances.

While used in pharmaceutical products, the industry uses pepper and pepper extracts only to a small extent, primarily in the forms of essential oil and oleoresin. The three main therapeutic uses of black pepper are as a stomachic (35%), digestive (18%) and tonic (12%), over 70% of which concern the treatment of alimentary tract disorders.

Possible medicinal uses being developed using pepper as an antimicrobial (anti-bacterial & anti-fungal), anti-fungal (including HIV), anti-protozoal and anti-cancer agent. For examples, studies are being conducted at present to test its usefulness against tuberculosis.

Both traders and the International Pepper Community (IPC) should follow developments in the application of the pepper derivatives piperine and piperidine, which may in future be used in new drug formulations based upon their wide pharmacological actions. They should also investigate the potential for using black pepper as a substitute for chillies used in pharmaceutical products requiring pungent properties.

Through research initiated by the flavour industry for its own interests into new methods for extraction, more uses for pepper may be found. For example, modern milling technologies are being developed, including cryomilling, selective grinding, cold-milling and centrifugal systems. These will promote the further analysis and use of pepper components.

The IPC could encourage these developments by acting as an information and promotional agency actively promoting pepper and pepper extracts in buyer countries in Europe and America.

Pharmaceutical traders should expand the utilisation of pepper through continuing to supply the volumes required in the West and through developing pepper utilisation in herbal and pharmaceutical markets in parts of the world where pepper is a traditionally accepted medical remedy. As pepper is an important ingredient in Ayurvedic, Chinese and Unani medicines, it is the growth of these markets in the West which will be most lucrative for pepper producers. This growth is seriously hampered by restrictions on importing Indian and Chinese herbal products into Europe and North America which powerful pharmaceutical and even western herbal medicine lobbies are instigating.

One of the first steps which the pepper industry must take is to gain recognition and licenses for Asian and Chinese herbal products in the European and North American markets. For this to occur, western governments should be made to accept that the clinical and toxicological research carried out in Asia and China for these products is as scientifically sound as that carried out in the West. If necessary reciprocity of market access for medical products must be brought up in bi-lateral as well as multi-lateral trade negotiations. It will require powerful lobbying from the producing countries and tough negotiations but once such approvals are obtained there is a vast market for pepper based herbal medical products conservatively put at between £200 - £250m.

1. INTRODUCTION

1.1 PURPOSE OF THE STUDY

This study was conducted for the United Nations Industrial Development Organisation hich was acting on behalf of the International Pepper Community to ascertain the demand for Piper nigrum L and its derivatives in the world market and the potential for further development. Its objectives were to investigate the global utilisation of pepper in pharmaceutical and herbal products and to provide information on volumes, trends in utilisation, and future development potential.

Specific areas of research regarding Piper nigrum L were:

- its current uses
- quantities used
- companies presently using it
- existing published research data which could be commercialized
- its biological activities/properties and treatment possibilities
- its potential uses and the research which now exists about it, and
- the methods used for extracting and separating pepper compounds in pharmaceutical and herbal medicines.

The research findings project growth trends in market demand for Piper nigrum L, and provide an estimate of the quantities which may be required in future. New producers and users of Piper nigrum L and its derivatives are suggested. The potential for further use and research and development possibilities are assessed. Recommendations for future development utilisation are also included.

1.2 BACKGROUND ON THE PROJECT TEAM

This comprises the work of McAlpine Thorpe & Warrier (MTW), Dr. Roland Hardman and consultancy team members on the global utilisation of black and white pepper (Piper nigrum L) in registered pharmaceutical products. Information was collected concerning the volumes of pepper used, trends in utilisation and future development potential.

The MTW team consisted of the following:

Project Leader: G. K. Warrier, BA, MSc (Mgmt) London, Dip. Int. Mgmt., HEC Paris and New York.

G. K. Warrier has a postgraduate degree in Management from the London Business School and degrees in International Business from Ecole des Hautes Etudes Commerciales in Paris and the New York University Graduate School of Business Administration. Mr. Warrier has more than 25 years of experience of marketing and consultancy in the international environment and has been an advisor to a number of governments and major international companies.

Pharmacologist: Dr. Roland Hardman, B. Pharm, BSc (Chem), PhD (Chem), FR Pharm S

Dr. Hardman is a pharmacist and chemist who specialises in pharmaceutical standards, and in medicinal and aromatic plants and spices for the food and pharmaceutical industries. He has been involved in the commercial production and processing of herbs and spices for essential oil and oleoresin production, and with medicinal plants for pharmaceutical products in Africa, South East Asia, Eastern Europe and European Community countries. Formerly a reader in the School of Pharmacy and Pharmacology at the University of Bath, Dr. Hardman is currently President of the Medicinal and Aromatic Section of the International Pharmaceutical Federation and is therefore conversant with current pharmaceutical developments.

Senior Consultant: Dr. Richard Foss, BSc (Agric), PhD (Agric Bot)

Dr. Foss is a plant breeder and agronomist with over twenty years of experience in developing a range of crops for the farmer and industrial end user, both in the UK and overseas. He has specialised in the technical and commercial development of condiment, spice, herb, essential oil and oilseed crops grown for the food, drink and pharmaceutical industries. He has concentrated upon tailoring crops to fit farming systems, and on the specific production processes of the industrial end user.

This whole systems approach to crop raw material development has resulted in significant cost savings and quality improvements for industrial crop procurement operations.

Research Coordinator and Market Researcher: Amy Corzine, BA, MA

Ms. Corzine, a consultant with the Herbal Division of MTW, has a writing and research background which includes experience of working within the homeopathic and herbal products industry in the US.

Market Researcher: Gayathri Radhakrishnan

Ms. Radhakrishnan specialises in market research in the pharmaceutical industry.

1.3 SURVEY METHODOLOGY

This report is based upon information obtained from the public domain using normal desk research methods. Computer database searches were made through Dialog, Data Star, Medline and the Herbal Medical Databases for relevant information. Some information was also obtained from limited access databases and from contacts using such databases in Europe and India.

Interviews were held with a number of contacts in the pepper community and in the cosmetic, pharmaceutical and herbal medical industries. Over 60 such interviews were held in Europe and the U.K.

Exclusive market and field research into the current pharmaceutical and herbal medical markets for pepper and its derivatives and extracts was conducted. Main suppliers and distributors were identified along with the prices of products containing them as components. Consumers were probed as to their awareness of the medicinal properties of pepper.

Market research was conducted through:

- Questionnaires sent to pharmaceutical, cosmetic and herbal companies and follow-up calls;
- Library research;
- Field Research, in which a total of 60 interviews were held with pharmacists, university professors, lecturers and researchers, pharmacologists, company directors, marketing and research personnel, distributors and retailers. Field reserach was conducted for one week in France and one week in Germany during August and September 1995.

Please see Section 3 for further information.

2. FINDINGS

2.1 CURRENT USES OF PEPPER AND PEPPER EXTRACTS

Pepper is used throughout the world as a condiment, and in traditional and modern medicines, cosmetics, and homeopathy. It has also been used as a natural pesticide and retardant of rancidity in oils, fats, and meats. The dried unripe fruit is used as a stomachic; carminative; aromatic stimulant; insecticide; diaphoretic; and antibacterial agent.

It stimulates tastebuds and thus causes reflex stimulation of gastric secretions. Employed in atonic dyspepsia, it also stimulates the mucous membranes and part of the nervous system, raising body temperature. It may be used as a gargle and externally as a rubefacient.

It is used as an abortifacient by, for example, East Africans, who also believe that the body odour resulting from eating the fruit repels mosquitoes and use pepper it as a pesticide.

Black Pepper is used either directly as a spice or as an extract in the form of pepper oleoresin or black pepper oil. White Pepper is used as a spice and in medicine. Other forms of pepper on the international markets, albeit in smaller quantities, are decorticated, green and pink pepper.

2.1.1 Description of Pepper

The words Pepper in English and Piper in Latin and Greek are derived from the Sanskrit Pippali.

Pepper began moving westward from India over 4,000 years ago and has been considered the most precious of all spices. It is responsible for the development of the various trade routes which led to the discovery and colonisation of eastern spice producing countries by western powers.

Black pepper represents 25% of the world's spice trade and is a major component of the flavour industry. Used in seed, root and fruit form, there are now thirteen varieties available commercially.

These varieties are usually named after the ports from which they are exported. Native to southern India, black pepper was introduced to tropical Asia, the Malagasay Republic and Brazil.

Today large quantities of black pepper are obtained from Indonesia, Sarawak and Brazil. Cultivated wild for the commercial market in Indonesia, South India, the West Indies, Brazil and China, it also grows in the Malay Archipelago, western India, tropical Asia, Madagascar, South America, and the Malagasay Republic.

Requiring shade and high humidity, black pepper grows in tropical forests. It does not require rainfall above normal, nor fertilizer, labour or much space to grow. It is influenced by climatic conditions, hence it is susceptible to sizable variations from year to year, i.e., there are wide fluctuations in price due to climate changes.

Black pepper is the dried unripe fruit of Piper nigrum Linn (family Piperaceae), a perennial climbing shrub. Its stem is strong and woody, bearing glossy, prominently nerved, ovate-oblong to orbicular leaves, up to 18 cm long and 12 cm wide, on 2 cm long petioles. Its flowers are white, usually dioecious, on glabrous spikes from 5 to 15 cm long. These are followed by 6 mm diameter globose, yellow, and then red, fruit. The fruit is globular, about 3-6 mm in diameter, with a wrinkled, reticulated dark brown or grey-black surface.

Pepper and pepper extracts are made from very unripe (green), unripe (black) and more ripe (white) fruits. Black pepper is obtained by the drying of immature berries whilst white pepper is the result of the removal of the mesocarp and/or pericarp of the mature berry.

In order to obtain white pepper, growers allow the fruit to ripen on the vine rather than picking and drying the unripe berries to produce the black variety. They soak the ripe fruit and then remove the dark skin (pericarp). Today most white pepper is decorticated pepper, which means that the outer layer is incompletely removed by machinery. It has, therefore, a slightly smaller diameter and its vascular bundles are visible as longitudinal lines on yellowish-white surfaces.

The characteristic quality of the taste and odour of Black Pepper is pungency.

2.1.2 Constituents of Pepper

Pepper contains the following constituents:

1. Volatile oil - to 2.5% in black pepper but less in white pepper - includes beta-bisaboline, camphene, beta-caryophyllene, alpha-cubebene, beta-farnesene, hydrocarveol, limonene, myrcene, myristicin, alpha- and beta-pinene, sabinene, safrole, alpha- and beta-selinene, alpha-thujene, etc. **[Table 1]**.

2. Alkaloids - in black and white pepper: piperine, piperidine and chavicine. Pepper contains up to 11% of piperine in the fruits, with piperanine; the yellow compound piperettine which hydrolyzes to piperidine and piperettic acid; and piperolein A and B.

The pungency of black pepper is produced by the alkaloid piperine, first isolated by Oersted in 1820. "Piperine (1-Piperinoylpiperidine) is responsible for the pungent hot taste of pepper and is used to impart a pungent taste to brandy. Piperine is used as an insecticide." [Phytochemical Dictionary, ed. J. B. Harborne and H. Baxter, publ. Taylor & Francis, London, 1993, ISBN 0-85066-736-4.]

Later a dark pungent resin named chavicine was obtained by Buchim (1876). Recent investigations confirm that piperine is the major pungent principle of pepper while chavicine was a mixture of piperine and several minor alkaloids.

Five new minor alkaloids have been identified: piperettine (Spring and Stark 1950); piperyline; piperolein A & piperolein B (Grewe et al., 1970); and piperanine (Traxler, 1971).

3. Miscellaneous: fixed oil, protein, traces of hydrocyanic acid; resins (to 6%); and starch (to 30%), etc.

2.1.3 Species Utilised

Some six different Piper species are presently used in pharmaceutical and herbal products. The most commonly utilised species is P. methysticum, while Piper nigrum L (black pepper) is the next most commonly used species.

The two primary products of Piper nigrum which are internationally traded are black and white pepper

2.1.4 Cosmetic Uses

The use of spices in cosmetics is limited. The biggest concern of the producer is that the oils can cause sensitization of the skin, apart from their obvious suggestion of food to the consumer.

Black pepper oil is used as a skin stimulant, colourant and warming agent in skin lotions. Minimal amounts are used by individual companies, however it is commonly used in fragrances. Lotions and toothpastes occasionally also use pepper oleoresin to give an extra bite to products.

Black pepper oil is an important component of perfumery formulations, aromatherapy and body creams. Only a very small amount is used in cosmetics due to its culinary associations and the problem of sensitization.

A dosage of 100 parts per million will usually offer a very strong flavour but for perfumes -- soap perfumes, for example -- an application strength 100 times that level would be required.

Pepper oil is used extensively in colognes, where it adds tenacity. Spices as essential oils are important perfumery constituents and even with the increase of modern perfumes based on synthetics, spice oils will continue to be a major part of the perfumery industry.

In general the addition of spice products and pepper in cosmetics must be avoided, apart from their use in well-tested perfumes where limits are suggested and controlled for safety.

["Spices in Cosmetics and Perfumery", Item 8.3 (Doc: ISG3:16 /91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

"All carbon dioxide extracted black pepper oils have to be carefully fractionated to remove all of the piperine homologues and resinoid components for application to skin contact fragrances without skin reddening. As early as 1967, carbon dioxide extraction of pepper was reported [108] and verified [109]. A GLC fingerprint analysis of pepper oil has been published [46]." [Proc. 12th, ICEOFF, D. A. Moyler et al, Vienna, 1992, pp. 52-100; page 2 of **Appendix 2.**]

2.1.5 Medical and Therapeutic Uses

The components of pepper presently being used in medicines are:

Base:	dried ground berries
Extract:	alcoholic and dry extracts
Oil:	steam distilled essential oil
Powder:	finely ground berries

The major uses of black/white pepper are within the food industry as a condiment and a flavouring agent, however they have also been used in medicines, particularly traditional medicines.

Black pepper is acrid, pungent, hot, carminative, anthelmintic, and is used as a febrifuge, stimulant and tonic. Externally it is used as a rubefacient, resolvent and stimulant to the skin. Internally it is used in a variety of ways for medicine.

Pepper appears to increase the bioavailability of the active ingredients with which it is mixed, perhaps by increasing intestinal absorption or by exerting an antioxidant effect during the first pass through the liver.

Used for the treatment of: blood, heart and respiratory diseases; bronchitis; cataracts; colds, coughs and influenza; coryza; eczema; headaches; haemorrhoids; intermittent fevers; neuritis; night blindness; syphilis; and urinary diseases, it is considered a useful urinary antiseptic and aid to digestion. Traditionally it is claimed to have excellent value in conditions simulating malaria, and is occasionally used in appendicitis, cholera and elephantiasis. It is also used in carminatives, anti-diarrhoeal and anthelmintic mixtures, and as an expectorant.

Apart from the traditional medicines of Germany, Switzerland and France, most Western medicine favours mono-ingredient products. Modern medicine recognises the value of synergistic interaction between ingredients in which each plant ingredient has a different role to play.

The following are modern and traditional medical systems which incorporate black pepper into their medicines.

(1) African Medicine

In Africa, taking pepper was believed to cause the body to emit an odour which repelled mosquitoes. In Eastern Africa, pepper was given to parturient women to keep their bodies warm, while near the Tanga region, large amounts were sometimes taken as an abortifacient. [Heil-u-Gewurzpfl., Braun K., 1929, p. 11.]

(2) Aromatherapy

Aromatherapy by definition is a branch of the perfume industry, although it is considered to have medical uses. It is reported to be responsible for a two percent increase in consumption of essential oils per year, and aromatherapists have great interest in pepper. Black pepper oil was described by one aromatherapist as "useful in massage to alleviate muscular tension with a warm stimulating effect on the mind". ["Spices in Cosmetics and Perfumery", Item 8.3 (Doc: ISG3:16/91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

In Aromatherapy, black pepper is used as "a warming oil which brings the blood to the surface, stimulating circulation. It is used to treat coughs, colds, high temperatures and muscular aches and pains. It is also employed to treat disorders of the digestive tract." (World of Herbs, by Lesley Bremness, Ebury Press, London, 1990, ISBN 0-85223-821-5, Aromatherapy Section).

Aromatherapy is now being used in selected cases of epilepsy. Whether oil of pepper is included in such trials is not known. Caution against kidney damage is stressed when oil of pepper (including piperine) is absorbed via the skin in aromatherapy oils. [**Aromatherapy Charts 357 and 355** for the oils of P. nigrum and P. cubeba respectively, from The Aromatherapy Practitioner Reference Manual, **Table 1.**]

THE AROMATHERAPY CHART

BOTANICAL Name COMMON Name/ plant part family/origin product / method/ availability	BIOCHEMICAL CLASS specific biochemicals	TRADITIONAL & ESOTERIC uses / actions	SYSTEMS									SAFETY DATA, Toxicity & Contra Indications
			Integumentary Skin Hair, Nails	Respiratory	Muscular / Skeletal	Cardio-vascular / Lymphatic	Immune	Digestive	Endocrine	Genito-Urinary / Reproductive	Nervous Within / Mind	
Piper nigrum **Black pepper** / peppercorns Piperaceae / India, Indonesia, Madagascar EO SD; oleoresin Note: black pepper is dried, whole, unripe fruit; white pepper is fruit with outer dark hull removed Note: essential oil from green pepper also produced	class: sesquiterpene, phenol ethers biochemicals: varies with sources, production methods monoterpenes (5%): α- & β pinenes, thujene, camphene, sabinene, carene, limonene*, phellandrene sesquiterpenes (approx. 69%): β-caryophyllene*, α-humulene, α gurjunene, α & β selinenes, α- & β-cubebenes, δ- & β elemenes, β bisabolene, calamenene alcohols: terpinen-4-ol, α terpineol, linalool, trans-pinocarveol, trans-carveol phenol methyl-ethers: perecymene 8-ol, methyl carvacrol ketones: dihydrocarvone acetophenones: m & p-methylacetophenones aldehydes: piperonal sulfur: N formyl piperidine acids: piperonylic	analgesic, antiemetic, antimicrobial, antiseptic (urinary), antispasmodic, antitoxic, aperitif, aphrodisiac, bactericidal, carminative, diaphoretic, diuretic (?), expectorant, febrifuge, laxative, odontalgic, rubefacient, stimulant (nervous, circulatory, digestive), tonic (nervous system, glandular, cardio vascular Character: Yang Body Type: Mesomorph Number: 2 Crystals: Malachite, Bloodstone Chakra: 3, 4 &1 Element : Fire Perfume Note: Mid Astrological: Mars	chilblains, bruises, cuts, wounds, dermatosis CAUTION: POSSIBLE IRRITATION; dilute local use	catarrh, chronic bronchitis, laryngitis, tonsillitis, worms chills, cold feeling	arthritis, muscle aches & pains, neuralgia, poor muscle tone, temporary paralysis, stiffness, rheumatism, tones muscles before sports, sprains	increases circulation (dilates local blood flow)	colds, flu, infections, viruses, may lower temperature (small amount of spice, not EO)	anemia (T,NEF, MDR-*peppercorns perhaps, because high levels of iron, not EO*), toothache, tonsillitis, antidote to fish & mushroom poisoning, increases saliva, stimulates liver-pancreas, aids reducing diets, (burns fat ?); stimulates appetite; colds, constipation, diarrhea, flatulence, heartburn, nausea, vomiting, restores colon tone		frigidity, impotence, stimulates kidney & urinary system, increases urine flow, aids detoxification; for uro genital discharges (e.g., leucorrhea)	mental stimulant, aids alertness, stamina, warms to indifference, eases life changes	tested at low dose non-toxic, due to highly variable compositions possible dermatitis, some chemicals are irritant (α-pinene, δ 3 carene, 1,8 cineole) impossible to draw conclusions on adverse effects by individual chemicals; use with care in massage or bath; large dose irritates & may damage kidneys

Table 1: Aromatherapy Chart

THE AROMATHERAPY CHART

BOTANICAL Name COMMON Name/ plant part family/origin product / method/ availability	BIOCHEMICAL CLASS - specific biochemicals	TRADITIONAL & ESOTERIC uses / actions	SYSTEMS: Integumentary Skin - Hair, Nails	Respiratory	Muscular / Skeletal	Cardio / Vascular / Lymphatic	Immune	Digestive	Endocrine	Genito-Urinary / Reproductive	Nervous Brain / Mind	SAFETY DATA, Toxicity & Contra Indications
Pinus sylvestris **Scotch pine needle**, forest pine, Norway pine / needles Pinaceae / all over the world EO by distillation inst Rare EO Note: In commmerce pine oils are lumped together under this name, often many varieties have been used, true *P. sylvestris* is rare EO Also produced: gum turpentine by SD oleoresin; contains: Δ-3 carene, dipentene, with pinene, sesquiterpene alcohols; root oil: an inferior EO by dry distillation of wood chips & root: α- & β pinene 40%, furfural, Δ-3 carene (50%) Other species: *Pinus cembra* and *Pinus mugo* var. *pumilio*: α & o *Pinus montana* or *Pinus mugo* - less steel Note *Pinus succinifera* is presumably the source of "Amber"- fossil resin from millions of years ago. Dust from gem industry is dry distilled to yield "crude amber oil"; this crude is SD into "rectified amber oil" Also, various resins are distilled under name of "Retinol" for industrial use [1] The "Amber" oil offered on the market may be one of these	class: monoterpene biochemicals: monoterpenes (high %): (-) β & (+) α° & (-) β pinene (> 41 & < 12 %), (-)-limonene (up to 30 %), Δ-3 carene sesquiterpenes: longifolene alcohols: borneol (2 %), α cadinol, muurolol [1] esters: bornyl acetate, (up to 10 %)	antimicrobial, anti-infectious, antifungal, antiphlogistic, antineuralgic, antirheumatic, anticarbuncle, antiseptic (pulmonary, urinary, hepatic), antiviral (?), bactericidal (staph. pigmented, E.coli, proteus, airborne: proteus, B. subtilis, pyogenes var. aureus, B. pyocyanin), balsamic, cholagogue, choleretic, deodorant, decongestant (lymphatic, vaso-constrict), diuretic (?), expectorant, hypertensive (MDR), hormone-like (?): antidiabetic (?) (pituitary pancreatic axis); cortisone-like (pituitary-adrenal-cortical(?)); & hormone-like (pituitary-gonads- male sexual stimulant)(?), insecticidal, restorative, rubefacient, sudorific, tonic-stimulant: adrenal (cortex) (?), circulatory (hypotensive) (MDR) and nervous systems; vermifuge Veterinary use: treatment of bronchial afflictions, balsamic, antiseptic, expectorant, insecticidal Character: Yang Body Type: Ectomorph Number: 3 Crystal: Malachite Chakra: 6 Element: Air & Light Perfume Note: Mid Astrological: Mars	boils, cuts, tissue, excessive perspiration, sores, eczema, psoriasis, ringworm, scabies, flea, congested skin: affects dermis layer, purifies skin especially grey, oxygen poor skin (smokers) CAUTION ON SENSITIVE OR DAMAGED SKIN; OILS HIGH IN DELTA-3-CARENE OR OLD AND OXIDIZED COULD BE MORE SENSITIZING	coughs breathing, asthma, bronchitis, catarrh, whooping coughs, sinusitis, sore throat, laryngitis, clears sinuses, stimulates & purifies respiratory tract, and circulation, increases secretion of mucus membrane of lungs, increasing CO^2 discharge; best used as inhalation	joint / muscular aches & pains, rheumatoid arthritis, rheumatism, gout, sciatica, edema-simple water retention, stiffness, Multiple sclerosis* (support only) (MDR)	stimulates poor circulation	immune stimulant: worms and colds fevers, colds, flu modulates inflammatory and allergic processes: olds severe infections	intestinal disturbances, hepatitis (MDR), inflamed gallbladder (MDR), stimulates metabolism (generous) olds diabetes (↑MDR)	supports thyroid (↑,↓NEF, MDR- caution with thyroid imbalance), olds diabetes (↑MDR), stimulates adrenal (cortisone-like) (↑NEF, *regulates*↑) stimulates pituitary-gonads (male) (↑NEF)	cystitis, urinary infection, inflamed & congested uterus, male stimulant & restorative,(?) prostate problems, impotence	fatigue, nervous exhaustion, debility & neuralgia, stress related conditions, adrenal cortex stimulant (↑NEF, *regulates*↑); olds Multiple sclerosis (support) (MDR); refreshes tired mind, cleansing, healing for hopelessness, low self esteem, lack of energy, weariness, nervous depletion	tested at low dose non-toxic & non-irritant; possible sensitization (it appears that pine oils high in Δ-3-carene, or oils that are oxidized could contain more potent sensitizing agents, causing dermatitis and eczema type reactions- therefore oils for use on the skin should be fresh); cross reaction possible to pine balsam, spruce, and Peru & Tolu balsam[1] avoid with allergenic conditions; avoid with prostate cancer
Piper cubeba *(Cubeba officinalis)* **Cubebs** / unripe berries Piperaceae / India, Indonesia EO SD: oleoresin in small quantities	class: sesquiterpenes biochemicals: mono- & sesquiterp...ree: cubebene (up to 80 %), caryophyllene, cadinene, sabinene, sesquiterpenoids: (-) cubebol also: 1,8 cineole, others	antiseptic (pulmonary, genito-urinary), antispasmodic, anti-infectious, antibacterial, antiviral (?), diuretic (?), expectorant, stimulant (nervous, muscular, cerebral), tonic (neurotonic, carminative) Character: Yang? Body Type Number Crystal Chakra Element: Fire Perfume Note: Astrological: Mars	dermatitis	bronchitis, catarrh, congestion, chronic coughs, sinusitis, throat infections	rheumatism; muscle inflammation, tension		immune stimulant(?): support in virus infections, flu	flatulence, indigestion, piles, sluggish digestion, intestinal colitis		acute & chronic infections: cystitis, vaginitis, leucorrhea, urethritis; diuretic (?); PMS	stimulates mind, olds fatigue neuro-muscular, mental	tested at low dose non-toxic, non irritant, non sensitizing, often adulterated, permitted food additive prolonged & excess use can cause diarrhea nervousness

The Aromatherapy Charts indicate toxicity and contraindications, naming some of the relevant compounds. In Aromatherapy Chart No. 357 the "Traditional and Esoteric Uses/Actions" tabulated are: analgesic, antiemetic, antimicrobial, antiseptic (urinary), antispasmodic, antitoxic, aperitif, aphrodisiac, bactericidal, carminative, disphoretic, diuretic (?), expectorant, febrifuge, laxative, odontalgic, rubefacient, stimulant (nervous, circulatory, digestive systems), tonic (nervous, glandular, cardio-vascular systems). This implies that the essential oil is absorbed through the skin and the lining of the lungs.

Its character is described as "Yang". [The Aromatherapy Practitioner Reference Manual, by Sylla Sheppard-Hanger, published by The Atlantic Institute of Aromatherapy, Florida, USA, 1995, ISBN 0-9643141-0-X, in two volumes, Vol. II, M-Z and indices.]

(3) Ayurvedic Medicine

Defined as one of the three acrids or "Thrikatu" used in Ayurvedic medicine, Pepper is used as an antiepileptic and analgesic in India. It, along with pepper and ginger, is an ingredient in many formulations used for digestive troubles and achlorhydria. Thrikatu is medicine for cough, obesity, elephantiasis, slackening of digestive capacity, asthma, and cold (chronic and new), according to Ashtanga Hridaya.

Ayurvedic medicine uses Piper nigrum to destroy Kapha and is said to be Vipaka in taste. It is said to stimulate the digestion; diminish semen; relieve asthma, cough, heart trouble and pains; heal diabetes and piles; and destroy worms. It increases Pitta, and decreases Kapha and Vata.

Finely ground black pepper and sesame oil mixed well and heated over a mild fire may be used, for example, to make an external poultice for body parts affected by paralysis.

White pepper is said to be neither too hot or cold and is best of all peppers. It is good for the eyes; heals fever, being particularly good for irregular fever; mixed with Ocimm sanctum, it can relieve flu; protects against filaria; cures elephantiasis; is useful in external applications for skin diseases which cause itching; acts against gonorrhea; and is used in fumes which epileptics inhale during their falls. Mixed with curds, it is applied to the eyes for Nyctalopia. [**Appendix 3**: "Spices in Ayurveda", P.K. Warrier, Managing Trustee, Arya Vaidya Sala, Kottakkal.]

According to Dr. M.S. Suseelappan, Professor and Head of the Department of Pharmacology at Government Ayurveda College, Tripunithura, pepper is among the most widely used medicines in Ayurveda. Its Sanskrit synonyms mean killer of poisons (MARICHA), corrosive (KRISHNA), antihelmenthic (VELLAJAM) and gives burning sensation (OCSHANA).

In Ayurveda, the fruit, root and leaves of Pepper are used as medicine. Berries are used in dried and fresh form and promote carminative and laxative action. Pepper serves as a remedy for asthma, cough, heart diseases, chronic dysentery, Xerophthalmia (night blindness), Hypersomnia and pain. It acts as a stimulant, digestant and decongestant and is advised to treat diabetes and piles. White pepper, considered to have properties higher than those of black pepper, has an anti-viral action and is useful as a tonic and for some eye

diseases and critical conditions like snake bite.

Pepper is the main ingredient in some of the most important Ayurvedic medicinal preparations used to control diseases. Pepper powder mixed with four other Ayurvedic drugs in a particular ratio cures serious coughs in which patients spit up infectious pus. The powder is also dried with cow bile for use as an eye ointment to rectify sight disorders. Mixed with other drugs, it is also used as a carminative and for sprue, cough, asthma, piles, tuberculosis and disorders of the spleen, among others.

Pepper is also useful as a stimulant or "vitalizer". For this purpose, a drink called Rasala is made with pepper powder, dried ginger, ocimun, sugar and curd.

Studies have been conducted which indicate that it is useful in remedies for the heart and in lactation. Piper longum has been used successfully with Butea monosperma in Ayurvedic medicines to treat chronic dysentery and worm infestation.

The activities -- anticonvulsive, vasodilatory, antihelminthic and anti-inflammatory -- tend to be those traditional to the medicine of South East Asia, including Ayurvedic medicine. [The Glossary of Indian Medicinal Plants, R.N. Chopra, S.L. Nayar, I.C. Chopra, Council of Scientific & Industrial Research, New Delhi, 1956].

"Pepper Fruit is used as an aromatic stimulant in cholera, in weakness following fevers, vertigo, coma; as a stomachic in dyspepsia and flatulence; as an antiperiodic in malarial fever; as an alterative in paraplegia and arthritic diseases; externally as a rubefacient, (i.e., it is absorbed by the skin), and as a local application for relaxed sore throat (again, absorbed through the skin) piles and skin diseases (which indicates its germicidal activity)."

In Ayurveda, black pepper has been used in the treatment of gonorrhoea, cholera, cough, disorders of the urinary system and malarial fever. Its aromatic properties have been used in treating dyspepsia and flatulence. Paste containing pepper is applied locally for boils, piles, rheumatic pain, headache, prolapsed rectum and toothache. An infusion has been used as a gargle to relax the uvula. [Indian Materia Medica, by Dr. A.K. Nadkarni.]

4) Chinese Medicine

The seeds of Piper nigrum L are used as antiepileptics and analgesics in China, where its fruit and roots have been used in remedies for malaria.

In Chinese medicine, dried pepper is combined with Rhisoma Pinelliae and ground to a powder, which is taken orally in the form of small pills to prevent vomiting, dyspepsia and abdominal pain. [Excerpt from The Chinese Pharmacopoeia.]

According to Chinese herbalism, pepper acts upon the body as a stimulant, diaphoretic, carminative, and diuretic, and increases gastric secretion, promoting stomach and intestinal peristaisis. Its traditional use is to remove phlegm and gas and to invigorate and detoxify the body through acting on the stomach and the large intestine. Pepper is used also to treat the gastrointestinal tract, stomach ache, nausea, vomiting, diarrhoea, dysentery, indigestion and lack of appetite, malaria, cholera, asthma in children, toothache, epilepsy, cramps due to

calcium deficiency, aching limbs and body, etc.

In modern Chinese medicine, it is used to treat nephritis (irritation of the kidneys), neurasthenia, diarrhoea in children due to indigestion, chronic tracheitis, wheezing, and various types of skin disease – many of which involve the local application of pepper. It is used locally for boils, relaxed sore throats, piles, paralytic afflictions, rheumatic pain, headache, prolapsed rectum and toothache. It is also used as an antiperiodic, in weakness following fever, and for vertigo, coma, flatulence, malarial fever, arthritic diseases, diseases of the spleen, leucoderma, lumbago, and night blindness. It increases biliousness, sleep and epileptic fits and facilitates menstruation, while in Malay it is used by women as an abortifacient. [Chinese Herbal Remedies, Albert Y. Leung: "Components of Pepper".]

(5) Homeopathy

In the preparation of the mother tinctures used in homeopathy, ethanoic extracts of Piper nigrum, with about 70% alcohol, are applied based on the pathogenesic symptoms, sexual excitement (priapism), and dryness and burning of nose. Less than 5kg/year of pepper of each species is used.

(6) Unani Medicine

Pippali or Piper nigrum is used in Unani medicine, the traditional medicine of the Middle East, for its pungent and nerve tonic qualities to help asthma, coughs, fever, piles and gonorrhoea. Ethanolic extracts of pepper are also used in these medicines and contain about 70% alcohol.

There are Unani remedies for asthma, coughs, fever, piles and gonorrhoea. Pippali or Piper nigrum specifically is used, and Ethanolic extracts containing about 70% alcohol. Thousands of tonnes are used annually in these products.

(7) Other Traditional Medical Uses

Other traditional uses are in vertigo, paralytic and arthritic disorders, and in combination with aperients to facilitate their action and to prevent griping in constipation. When added to quinine, it increases its action. Pepper is also used as a gargle in the paralysis of the tongue. [A Modern Herbal, Mrs. Grieve.]

According to the Hager monograph of 1994, pepper is used as a digistivum and externally against scabies and neuralgia. [Item from Dr. R. Wohlfart, Kneipp-Werke, Wurzburg, Germany.]

(8) General Medical Uses

- To clear stuffy nose
- As tonic for paraplegia
- As counter-irritant for sprains and muscular aches

- Liniment applied to bites of venomous reptiles
- In the treatment of coughs, colds, high temperatures, muscular aches and pains
- Used to treat disorders of the digestive tract
- Antifungal agent, e.g., Benzine extracts of Piper nigrum, essential oils
- Antiflammatory properties, prevents lipid absorption

Piper nigrum L is also useful for perioxidation and aids absorption by the intestine. [Section 3.4 Summary of Database Research on pp. 62 - 67 of this report]. It is useful as a preserver and chemoprotective for chemical carcinogenesis (demoline reduces carcinogy), and has liver protective potential.

(9) Results of Overdosage

Large doses of black pepper bring a burning sensation and a feeling of pressure everywhere. Other effects on the parts of body have been noted as follows:

Mind - becomes sad, apprehensive, unable to concentrate, starts at unexpected noises.

Head - develops heavy headache, as if the temples were pressed in with pressure on the nasal and facial bones. The eyes ache, become inflamed and burn. The face becomes red and burns. The nose itches to the point of sneezing and nosebleed. The lips dry up and crack.

Throat - feels raw, sore and burns, sometimes with pain in the tonsils.

Stomach - feels full, experiences discomfort, colic, flatulence and cramps. Tympanites and great thirst are also experienced.

Chest - experiences palpitation, cardiac pain, slow intermittent pulse, pain with cough, dyspnoea.

Urinary - Bladder burns and feels full or swollen and there is burning in the urethra with difficult micturition.

[For the above, see Homeopathic Interia Medica with Reportory by Boenicke. For more information about the consequences of overdosage, see The Dictionary of Materia Medica, Vol. III, by J. H. Clarke, MD.]

2.1.6 Pharmaceutical and Herbal Product Uses

Black and white pepper are utilised in raw material form in pharmaceutical products mainly as the base consisting of dried ground berries (76%), while 12% of products contain the extract and 12% the oil.

While used in the pharmaceutical industry, pepper and pepper extracts are used only to a very small extent in the forms of essential oil and oleoresin. The amount used is negligible when compared to the current and rising demands of the flavour industry.

In the pharmaceutical industry, they are used as ingredients in carminative mixtures, in liniments as aromatic stimulants, and externally as rubefacients or pain balms in ointments.

Pepper is also used as a flavouring in carminative herbal remedies. Piper nigrum and Capsicum plus other piper spp. are used. The pepper extracts Oleoresin (acetone extract in the UK, ether in the US), Ethanol/methanol, and Essential Oils produced by distillation are also used, but the volume is insignificant.

The three major therapeutic uses of pharmaceutical products containing black and white pepper are as a stomachic (35%), as a digestive (18%) and as a tonic (12%). Over 70% of the utilisation is in treatment of disorders of the alimentary tract. One product is used as a cardiovascular treatment and another as a sedative, however, normally Piper methysticum is preferred for use in sedative products.

Most products which use pepper are multi-ingredient products with anything from four to 25 different constituents. Most of the constituents are derived from plants, but a few are not. Products which contain Piper nigrum as an ingredient include the following: **(Table 2: Composition of Pharmaceutical and Herbal Products which contain pepper).**

- Abtei Mariahilf
- Anchoongsan
- Digeston
- Doppelstern
- Gallevin
- Hoshi Ichoyaku
- Kensyu Rokshi Sog
- Klosterfrau Magenton
- Klosterfrau Melissen
- Melisana
- Melisana Kloster
- Poconeol N22
- Saeng Wi Dan
- So Ryuk Dam
- Vital-Tonikum
- Wala
- Weeryuk

World pharmaceutical markets were searched for evidence of the utilisation of certain pepper derivatives. Piperine, chavicine, piperidine and piperettine were investigated, but none of these are presently used in registered pharmaceutical products.

These contrasting perceptions will affect the future market for black and white pepper raw materials.

TABLE 2:

Composition of Pharmaceutical and Herbal Products Which Contain Pepper

Product Name	Ingredients
Abtei Mariahilf	Alpinia officinarum Angelica archangelica Cinchona peruvianae Citrus aurantium Elettaria cardamomum Ethanol Eucalyptus globulus Eugenia caryophyllus Inula helenium Juniperus communis Melissa officinalis Mentha piperata Myristica fragrans Pimpinella anisum Piper nigrum Zingiber officinale
Anchoongsan	Alpinia officinarum Cinnamomum zeylanicum Corydalis Foeniculum vulgare Galega officinalis Glycyrrhiza glabra Ostrea gigas Pachyma hoelen Piper nigrum
Digeston	Foeniculum vulgare Piper nigrum Terminalia chebula Zingiber officinale
Doppelstern	Achillea millefolium Acorus calamus Artemisia absinthum Camphor Carduus benedictus

Product Name	Ingredients
Dopplestern (ctd.)	Coriandrum sativum Elettaria cardamomum Foeniculum vulgare Galega officinalis Gentiana lutea Glycyrrhiza glabra Guaiacum resin Humulus lupulus Juniperus communis Matricaria chamomilla Mentha crispa Nicotinamide Piper nigrum Prunus laurocerasus Pyridoxine Tannins Thiamine Valeriana officinalis Zingiber officinale
Gallevin	Angelica archangelica Artemisia absinthum Centaurium erythraea Cyanara scolymus Frangula alnus Gentiana lutea Glycyrrhica glabra Helenium autumnale Melissa officinalis Piper nigrum Taraxacum officinale
Hoshi Ichoyaku	Chasmanthera palmata Magnesium Menthol Piper nigrum Sodium Zingiber officinale
Kensyu Rokushi. Sog	Aloe africana Besoar Bile Borneol Bufonis venemum Crocus sativus

Product Name	Ingredients
Kensyu Rokushi. Sog (ctd.)	Glycyrrhiza glabra Musk Panax ginseng Piper nigrum
Klosterfrau Magenton	Angelica archangelica Cynara scolymus Gentiana lutea Glycyrrhiza glabra Helenium autumnale Melissa officinalis Piper nigrum
Klosterfrau Melissen	Alpinia officinarum Angelica archangelica Elettaria cardamomum Eugenia caryophyllus Gentiana lutea Helenium autumnale Melissa officinalis Myristica fragans Piper nigrum Zingiber officinale
Melisana	Alpinia officinarum Angelica archangelica Coriandrum sativum Elettaria cardamomum Eugenia caryophyllus Gentiana lutea Helenium autumnale Melissa officinalis Myristica fragans Piper nigrum Zingiber officinale
Melisana Kloster	Angelica archangelica Elettaria cardamomum Eugenia caryophyllus Galega officinalis Gentiana lutea Helenium autumnale Melissa officinalis Myristica fragans Piper nigrum

Product Name	Ingredients
Melisana Kloster (ctd.)	Quassia amara Zingiber officinale
Poconeol N22	Citrus limonum Guettarda uruquensis Piper nigrum
Saeng Wi Dan	Agastache Alpinia officinarum Amomum aromaticum Atractylodes Cinnamomum zeylanicum Crataegus oxyacantha Cyperus rotundus Elettaria cardamomum Eugenia caryophyllus Glycyrrhiza glabra Mentha piperita Pachyma hoelen Piper longum Piper nigrum Poncirus Rubia tinctorum Saussurea lappa Terminalia Zingiber officinale
So Ryuk Dan	Amomum aromaticum Areca catechu Atractylodes Cinnamomum zeylanicum Cyperus rotundus Elettaria cardamomum Eugenia caryophyllus Galega officinalis Glycyrrhiza glabra Hordeum vulgare Magnolia Myristica fragans Panax ginseng Pinellia ternata Piper longum Piper nigrum Siam benzoin Zingiber officinale

Product Name	Ingredients
Vital-Tonikum	Angelica archangelica Arnica montana Ascorbic acid Cyanocobalamin Cynara scolymus Elettaria cardamomum Eugenia caryophyllus Flavin mononucleotide Foeniculum vulgare Galega officinalis Gentiana lutea Glycyrrhiza glabra Helenium autumnale Illicium verum Melissa officinalis Myristica fragans Nicotinamide Piper nigrum Populus Pyridoxine Quassia amara Retinol Thiamine Vitamin E Zingiber officinale
Wala	Acorus calamus Artemisia absinthum Berberis vulgaris Calendula officinalis Crataegus oxyacantha Echinacea angustifolia Eucalyptus globulus Gentiana lutea Peru Balsam Piper nigrum Prunus spinosa Salvia officinalis Silicon dioxide Silver Zingiber offinale
Weeryuk	Atractylodes Catalpa Cinnamomum zeylanicium

Product Name	Ingredients
Weeryuk (ctd.)	Glycyrrhiza glabra Machilus Piper nigrum Saussurea lappa Thiamine Zingiber officinale

2.1.7 Use as a Pesticide

Classed as a stomach poison, its roots and leaves are effective in the control of plant pests. They are ground into powder and dusted onto plants. The method is easily imparted to farmers, who may do this themselves without the aid of complicated technology. [A Study on the Production Possibilities of Botanical Pesticides in Developing Countries, by Attila Kis-Tamas. UNIDO Consultant, UNIDO, 11 July 1990, pp. 58-9 & 64.]

Piperaceae (Piper betle L. Betel pepper) controls Diaphania hyalinata (Melonworm) and Dysdercus cingulatus (cotton stainer). [Ibid., p. 70.]

Pipercide is used as an insecticide, while pepper oils also have grain protectant activity.

2.1.8 Other Uses

Significant as a flavouring, black pepper is also used as a natural preservative to retard rancidity in oils and fats, frozen ground pork, beef and lard.

It has also been used as a binding agent, in tablet manufacture, and by the soap industry.

2.2 MARKET RESEARCH AND ANALYSIS OF THE MARKET FOR PIPER NIGRUM L

2.2.1 Market Size and Structure

In 1970-75, the average annual international spice trade was estimated to be 222,000 tonnes, valued at US$300 million; it is currently estimated to be 400,000 tonnes, valued at US$1,500 million. Pepper is the principle spice imported in terms of volume and value in international trade. Estimated trade in pepper alone is 130-135,000 tonnes. End-use pattern of spices by country and by main end-use sector are given in **Table 3**.

Eighty-five percent of the spice trade is unground spice while the rest consists of ground spices, oils and oleoresins. There is an expanding number of developing countries establishing oleoresin extraction and other processing facilities.

The current pharmaceutical and herbal medical market size for pepper and pepper extracts is negligible, estimated only at a maximum of 50 tonnes!

Recent market data is available from Singapore, pepper being its most important spice export. In 1993, Pepper accounted for 33,092 metric tonnes (32% of its total spice business), which was exported mainly to the Netherlands and Germany. For quality, there is the Singapore Standard 315:1986 - Specifications for Black Pepper and White Pepper (Whole and Ground). This Standard is being updated with "steam heat based natural sterilisation", which is the method that McCormick Ingredients South East Asia Pte Ltd, Singapore and Hiang Kie Pte Ltd., Singapore, use for pepper. [**Appendix 4:** "Singapore Spice Trade", Tan Seok Lee, 4emes Rencontres Internationales - Nyons, 5, 6, 7 decembre 1994, pp. 76-79.]

TABLE 3

End-use Pattern of Spices By Country and By Main End-use Sector (Percentages)

Country	Industrial	Retail	Institutional
Western Europe			
Germany, Fed. Rep.	50	40	10
United Kingdom	50	50	a/
France	50	35	15
Netherlands	60	40	a/
Italy	40	50	10
Belgium/Luxembourg	45	45	10
Spain	50	45	5
Switzerland	55	35	10
Sweden	50	40	10
Denmark	50	30-35	15
Finland	40	40	20
North America			
United States	66	34	b/
Canada	55-60	30-35	5-10
Asia and the Pacific			
Japan	70	20	10
Australia	(90)		
New Zealand	50-55	40-45	5-10

Source: ITC

High quality pepper is produced by India, Thailand, Vietnam, Madagascar, Sri Lanka, Malaysia and Brazil. Lampong pepper, which is produced in southern Sumatra, has the largest supply and is the most popular grade of pepper in the spice trade.

Table 4 shows the trade structure and channels for herbs in Western Europe [from "Dry Culinary Herbs: An Overview of Selected Western European Markets", Item 9.2 of the Provision Agenda of the Third Session of the International Spice Group, International Trade Centre, UNCTAD/GATT and the Commonwealth Secretariat, Doc: 1563:20/91].

2.2.2 Market Analysis and Findings

The total world crop is in excess of 70,000 metric tonnes per year, one third of which is imported by the United States of America. India is the largest producer and consumer of spices: 36% of its spice trade is pepper exports.

Consumption of spices is influenced by the size of a population, its real income and standard of living, the state of a country's economy and its culinary and social habits. Less consumption in the home is attributed to more women entering the labour force and increasing the demand for "ready to eat" food.

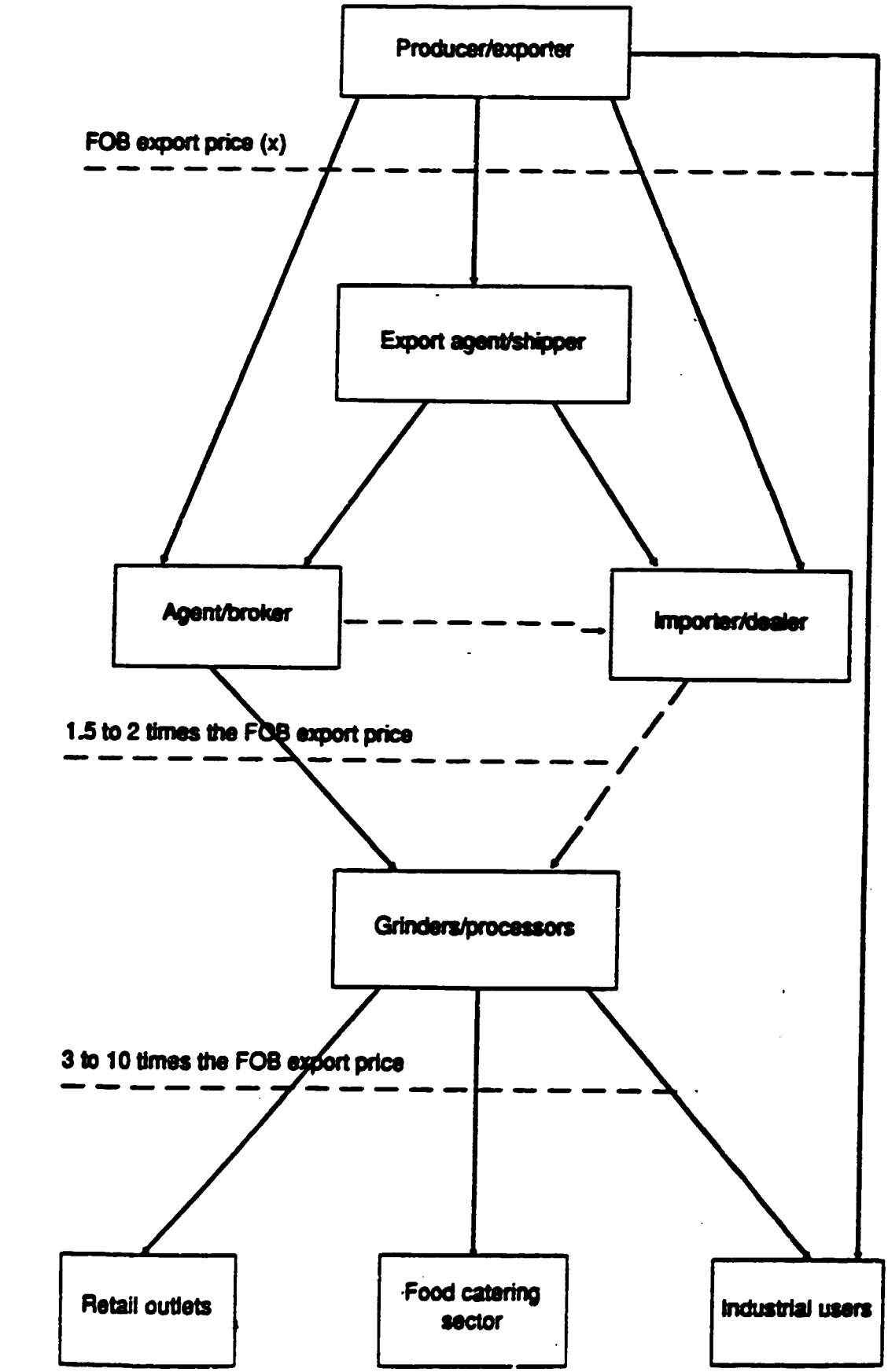
(1) Growth Rates

Global trade in spices has been increasing, according to the International Spice Group (ISG). From an annual average of 220,000 tonnes valued at US$300M during the period 1970-75 to more than 300,000 tonnes valued at about US$ 750 M in 1978-90, and to 370,000 tonnes valued at US$1,000M in the period 1981-85. Global trade in spices in 1988 was valued at US$ 1,581 M.

Potential for faster growth is enormous. Global demand could increase dramatically in the rapidly growing food processing industry, for example, through a minor shift in consumer preferences. A well-conceived, long-term strategy involving all producers and trade operators, and also end-users, is necessary. ["Strategies and Measures for Promotion of Spices", Item 10.4 (Doc: ISG3:24 /91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

TABLE 4:

Trade Structure and Channels for Herbs in Western Europe



(2) Main Suppliers to the Pharmaceutical and Herbal Industries

These are also the suppliers to the dominant flavour industry. Some U.K. examples of international companies are:

Universal Flavours PLC, Bilton Road, Bletchley, Milton Keynes, MK1 1HP.
Tel.: 01908 270270; Fax: 01908 270271.

H.E. Daniel Ltd., Longfield Road, Tunbridge Wells, Kent TN2 3YE.
Tel.: 01892 511444; Fax: 01892 510013.
(Indian black pepper oil by steam distallation: £39.50 per kg. Indian oleoresin: £24per kg. These prices are from stock in the UK.)

Lionel Hitchin Ltd., Gravel Lane, Barton Stacey, Nr. Winchester, Hants., SO21 3RQ.
Tel.: 01962 760815; Fax: 01962 760072.
(Black pepper oil produced on site by steam distillation costs: £60 per kg. and Oleoresin: £20 per kg.)

British Pepper and Spice Co. Ltd., Rhosili Road, Brack Mills, Northampton, NN4 7AN.
Tel.: 01604 766461; Fax: 01604 763156.

McCormick Ingredients South East Pte. Ltd., Singapore, with its USA branch at: McCormick, Baltimore, MD, USA, and supplying the world-wide chain of MacDonalds' fast food outlets.

(3) Manufacturers of Pharmaceutical and Herbal Products containing Black Pepper and their Therapeutic Uses

The utilisation of black and white pepper in pharmaceutical and herbal products is summarised in **Table 5: Utilisation of Pepper in Pharmaceutical and Herbal Products.**

It can be seen from this table that only 17 registered pharmaceutical or herbal products which contain black or white pepper are presently manufactured and sold onto the world market. Of these 17 products, 35% are produced in Germany, 24% in Korea and 12% each in Japan and Switzerland. The only other countries in which products containing pepper are manufactured are France, the Netherlands and Pakistan.

(4) Traders of Products Containing Black Pepper

The 17 products containing black or white pepper are marketed by 15 companies, of which eight are located in Europe and six in the Far East. The main pharmaceutical end users of pepper in Europe are thought to be Klosterfrau Vertribesgesellschaft, Queisser Pharma and Abtei Pharma in Germany and Kloostervrouw in the Netherlands. In the Far East, the main end users are Samhee and Sudo in Korea. The full list of actual end users, including potential traders, is given in **Table 6.**

TABLE 5

Utilisation of Pepper in Pharmaceutical and Herbal Products

Country and Manufacturer	Ingredient Form & Product Name	Therapeutic Use
France	Base	
Homeo Sud Ouest	Poconeol N22	Other Therapeutic Products
Germany		
	Base	
Klosterfrau Vertrib.	Klosterfrau Melissen	Other Therapeutic Products
Klosterfrau Vertrib.	Vital-Tonikum	Tonic
Lassel	Gallevin	Stomachic
Queisser	Doppelstern	Tonic
	Extract	
Klosterfrau Vertrib.	Klosterfrau Magenton	Stomachic
	Oil	
Abtei Pharma	Abtei Mariahilf	Other Therapeutic Products
Japan		
	Base	
Sogo Seiyaku	Kensyu Rokushi.Sog.	Cardiovascular
	Powder	
Hoshi Seiyaku	Hoshi Ichoyaku	Antacid
Korea		
	Base	
Cho Seon Ph. & T.	So Ryuk Dam	Stomachic

Country and Manufacturer	Ingredient Form & Product Name	Therapeutic Use
Korea (ctd)		
	Base	
Sam Hwan	Weeryuk	Stomachic
Samhee	Anchoongsan	Stomachic
Sudo	Saeng Wi Dan	Digestive
Netherlands		
	Oil	
Kloostervrouw	Melisana	Sedative
Pakistan		
	Extract	
Oriental Laboratories	Digeston	Stomachic
Switzerland		
	Base	
Melisana	Melisana Kloster.	Digestive
Schlatter	Wala	Digestive
Schlatter	Wala	Diuretic

TABLE 6

Actual End Users and Potential Traders of Pepper for Pharmaceutical Use

Actual End Users	Potential Traders
France	Germany
Homeo Sud Ouest	Paul Muggenburg
	Heinrich Ambrosius
Germany	E.H. Worlee
Abtei Pharma	Martin Bauer
Klosterfrau	
Vertribesgesellschaft	Japan
Lassel	Takasago
Queisser	Tanemura
Japan	
Hoshi Seiyaku	
Sogo Seiyaku	
Korea	
Cho Seon Ph. & T.	
Sam Hwan	
Samhee	
Sudo	
The Netherlands	
Kloostervrouw	
Pakistan	
Oriental Laboratories	
Switzerland	
Melisana	
Schlatter	

(5) Main Suppliers of Black Pepper

Main pepper suppliers include:

- Universal Flavours plc
- H.E. Daniel Ltd.
- Lionel Hitchin Ltd.
- British Pepper and Spice Co. Ltd.
- McCormick Ingredients South East Pte Ltd.

(6) European and North American Markets for herbal products

The annual budget of the American Spice Trade Association (ASTA) is approximately US$250,000, which it spends upon media ads, trade/customer relations, the sale of support activities, and in store merchandising.

A search of the US Market revealed no manufacturers using pepper in registered pharmaceutical or herbal products. Block, Marion Merrell Dow, Sanofi Winthrop, Numark Laboratories and Standard Laboratories all use Capsicum raw materials and perhaps black pepper could substitute for these in a proportion of the products. [Ref.: Dr. Foss]

Below is a breakdown of the current European and North American maraket for herbal medicine:

Market size and per capita consumption - 1994

Country	Herbal Medicine Market size (£ p.a.)	Consumption Per capita (£ p.a.)
Germany	1,400	18.02
France	166	2.02
U.K.	88	1.53
Italy	82	1.42
Denmark	62	12.16
Spain	30	0.78
Belgium	26	2.63
Netherlands	25	1.67
Portugal	12	1.21
Ireland	3.6	1.03
Greece	0.7	0.07
Luxembourg	0.6	1.50
Total EC	**1,845.9**	**5.41+**

+ weighted by population size in order to give the average per capita spending per annum.

Historic and projected growth 1985 - 1999 (% per annum)

Country	1985-1990	1990-1995	1995-1999
Germany	8	6	7
France	6	8	9
U.K.	15	14	16
Italy	15	11	13
Denmark	8	10	14
Spain	15	9	10
Netherlands	8	13	16
Belgium	15	8	10
Portugal	15	9	11
Greece	5	12	15
Ireland	12	10	9
Luxembourg	5	6	8

OTC Retain sales in Canada
(US$ million 1989-1992)

US$ million	1989	1990	1991	1992	Growth	Per annum
Laxatives	57	50	53	52	- 10%	- 2%
Throat lozenges	21	22	22	22	+ 5%	+1%
Vitamin & minerals	83	96	44	46	- 80%	- 15%
Herbal medicines	60	69	80	84	+ 40%	+ 12%

Market segmentation of the US herbal medicine (remedy) market

US$ million	1985	1990	1991	1992
Herbal products sold via NFI	130	225	256	290
Mass market - drugstores	136	217	218	225
- foodstores	78	136	136	136
Multi-level	72	143	171	205
Mail order	25	45	46	47
Health care practitioners	18	27	30	31
Asian herbal shops	15	33	35	36
Total	**474**	**846**	**892**	**974**

Source: McAlpine, Thorpe & Warrier reports

Potential market for pepper products

If pepper producing countries are able to clear the Western Governments' regulatory barriers for Asian and Chinese products at least 3% of this market worth approximately £ 9 billion will be open to pepper based products, i.e. a market of about £ 250 million.

(7) Pepper Substitutes

Prices, etc., for anti-inflammatory (synthetic steroidal and non-steroidal), anticonvulsive, etc., pharmaceticals can be found. However, this would best be done when the pepper sourced alternative is known and "approved" for a defined medical use.

(a) Organic Substitutes for Pepper

Capsicum raw materials are used as natural sources of pungency in many pharmaceutical products and these probably compete with pepper.

Several other species of Piper are used as substitutes for Pepper. The best known are P. clusii DC and P. guineense Schum & Thonn. in tropical Africa, P. saigonense DC from Vietnam, and P. longifolium, Ruiz & Pav., from tropical America. Other plant with peppery fruits which may be used as a pepper substitute are Schinus molle L. in tropical America, Xylopia aethiopica, A. Rich, in West Africa, and Zanthoxylum piperitum DC, Z. alatum Roxb. and Z. bungei, Planch, in eastern Asia.

Linseed, mustard seed, wheat, pea-flour, sago and ground rice have also been used in the adulteration of pepper. At one time fictitious peppercorns made of oil-cake and clay with a little cayenne added were also used.

Since the nitrogen content in pepper and its oleoresin is used to measure the percentage of piperine, foreign nitrogen containing substances such as urea, glycine, hexamethylene tetramine and beta-cinnamyl acryloyl piperide were sometimes added as adulterants to augment the percentage of piperine.

(b) Synthetic Substitutes for Pepper

Negligible at this stage because competitors are not yet identified.

No direct synthetic substitutes for pepper in pharmaceutical products were found. The flavour industry will continue its high demand for pepper. Pharmaceutical uses are simply a spin-off and the demand for medicinal purposes is unlikely ever to affect the volume required by the flavour industry.

(c) Current Technological Research

Dry extracts are now becoming more widely used as raw materials in the manufacture of pharmaceutical products.

The following new technologies are being developed for the extraction of plant raw materials:

- ultrasound extraction
- microwave extraction of essential oils
- supercritical carbon dioxide extraction
- membrane separation

There is no evidence yet that these new processes are being used to extract pepper raw materials for pharmaceutical use.

Recent developments include quality upgradation through:

- quality education and awareness programmes for growers, intermediate traders and exporters of spices
- encouraging the set-up of processing and cleaning units, and
- quality and evaluation labs and encouraging exporters to set up their own better packaging
- research and development into new end-products, e.g., the "ready-to-eat" foods market which will tap into the potential in the current changing market.

New technology is being applied to pepper as follows:

- a natural method for the sterilisation of spices by a heat process reduces bacteria contamination
- genetic engineering
- cytonic grinding to enhance aroma
- flavour and spice blending technology.

(d) Main Competitors/Synthetic Competition

Competition from synthetic substitutes for pepper is negligible at this stage because competitors have not been identified, according to Dr. R. Hardman.

(8) Quality Requirements in the Market Place (from Dr. G.K. George)

Quality in the spice industry generally means freedom from physical and microbial contamination, insect infestation, filth, pesticide residue, heavy metal and conformity to the characteristics of a grade specification.

Factors which affect the quality of spices may be physical, hygienic or bio-chemical. Physical factors are normally related to appearance while bio-chemical ones are controlled by

the inherent quality of the spices. Both are important, but quality specifications place priority upon hygiene, as unhygienic produce is not fit for consumption.

Consumers today, especially in the more materially advanced countries, are more conscious of the health hazards involved in consuming unhygienically-processed spices. Their governments are introducing very stringent quality regulations to protect them from unhygienic food materials. Importing countries sometimes complain about poor hygiene quality, as spices are generally cultivated on small farms by people who often belong to the lower strata of society and are unaware of hygiene requirements.

These problems can be eliminated if producers follow strictures on clean cultivation with the use of safe and recommended plant protection chemicals. Harvested produce must be handled under sanitary conditions during drying, cleaning, grading, storing and transport operations.

Spices will be rejected unless producers adhere to prescribed limits in the following areas:

- Moisture
- Ash
- Acid insoluble ash
- Micro-organisms
- Mycotoxin
- Pesticide residues
- Heavy metals
- Non-permitted colours (artificial colouring is not permitted) and
- Animal filth

Filth of any kind is a serious contamination in spice. Filth may be excreta of mammals, birds and living organisms, and/or insect fragments, etc. Filth contains a large population of micro-organisms, including pathogenic ones. Contamination by filth is highly objectionable, as it makes spices non-consumable.

Spices are sought after for their individual aromas and flavours. To call a spice a spice, it should have the correct type of bio-chemical constituent at the required level. An important biochemical constituent looked for in pepper is piperine.

Starch is added to ground pepper and other spices, according to prescribed levels approved by consuming countries. Edible starch is added during processing in order to make spices free flouring. The barest minimum should be used, as starch is added to spices to improve physical quality.

Edible gum is also sometimes added. This is used to improve physical quality and convenience in application.

Specifications have been drawn up for different spices and products which contain them regarding physical and microbial contamination, insect infestation, filth, pesticide residues, heavy metals and other contaminants in advanced countries. For example, the

American Spice Trade Association has limited the number of contaminants permitted in different spices, as may be noted in **Table 7**: **"Cleanliness Specifications"** (May 1991) on the following page. Extraneous matter is defined as "everything foreign to the product itself and includes, but is not restricted to, stones, dirt, wire, stem, stick, non-toxic foreign seeds, excreta, manure and animal contamination."

TABLE 7

Cleanliness Specifications

	Whole Insects, Dead	**Excreta Mammalian**	**Excreta Other**	**Mould**	**Insect Defiled/ Infested**	**Extraneous Foreign Matter**
	By Count	By Mg./Lb.	By Mg./Lb.	% By Wgt.	% By Wgt.	% By Wgt.
Name of Spice, Seed or Herb						
All Spice	2	5	5.0	2.00	1.00	0.50
Anise	4	3	5.0	1.00	1.00	1.00
Sweet Basil	2	1	2.0	1.00	1.00	0.50
Caraway	4	3	10.0	1.00	1.00	0.50
Cardamom	4	3	1.0	1.00	1.00	0.50
Cassia	2	2	1.0	5.00	2.50	0.50
Cinnamon	2	1	2.0	1.00	1.00	0.50
Celery seed	4	3	3.0	1.00	1.00	0.50
Chillies	4	1	8.0	3.00	2.50	0.50
Cloves	4	5	8.0	1.00	1.00	1.00*
Coriander	4	3	10.0	1.00	1.00	0.50
Cumin seed**	4	3	5.0	1.00	1.00	0.50
Dill seed	4	3	2.0	1.00	1.00	0.50
Fennel seed	SF(2)	SF(2)	SF(2)	1.00	1.00	0.50
Ginger	4	3	3.0	SF(3)	SF(3)	1.00
Laurel leaves	2	1	10.0	2.00	2.50	0.50
Mace	4	3	1.0	2.00	1.00	0.50
Marjoram	3	1	10.0	1.00	1.00	1.00
Nutmeg (broken)	4	5	1.0	SF(4)	SF(4)	0.50
Nutmeg (whole)	4	0	0.0	SF(5)	SF(5)	0.00
Oregano	3	1	10.0	1.00	1.00	1.00
Black pepper	2	1	5.0	SF(6)	SF(6)	1.00
White pepper	2	1	1.0	SF(7)	SF(7)	0.50
Poppy seed	2	3	3.0	1.00	1.00	0.50
Rosemary leaves	2	1	4.0	1.00	1.00	0.50
Sage	2	1	4.0	1.00	1.00	0.50
Savory	2	1	10.0	1.00	1.00	0.50
Sesame seed	4	5	10.0	1.00	1.00	0.50
Sesame seed, Hulled	4	5	1.0	1.00	1.00	0.50

Tarragon	2	1	1.0	1.00	1.00	0.50
Thyme	4	1	5.0	1.00	1.00	0.50
Turmeric	3	5	5.0	3.00	2.50	0.50

* Clove Stems - A 5% allowance by weight for unattached clove stems over and above the tolerance for Other Extraneous Matter is permitted.

** Cumin Seed - 9.5% total Ash, 1.5% acid insoluble ash.

(2) Fennel Seed: In the case of fennel seed, if more than 20% of the sub samples contains any rodent, other excreta or whole insects, or an average of 3 mg/lb of mammalian excreta, the lot must be reconditioned.

(3) Ginger: More than 3% mouldy pieces and/or insect infested pieces by weight.

(4) Broken Nutmeg: More than 5% mould/insect defiled combined by weight.

(5) Whole Nutmeg: More than 10% insect infested and/or mouldy pieces, with a maximum of 5% insect defiled pieces by count.

(6) 1% mouldy and/or infested pieces by weight.

(7) 1% mouldy and/or infested pieces by weight.

The FDA has established defect levels to represent the approximate limits around which they will take legal action against produce from import or remove it from the market. **Table 8** below shows defect action levels presented in April, 1984 which were in effect in May, 1991.

TABLE 8

Defect Action Level of Food and Drug Administration (FDA)

Produce	Defect	Action Level
Pepper whole	Insect filled and/or mould	Average of 1% more pieces by weight insect infested and/or mouldy.
	Mammalian	Average of 1 mgm or more of mammalian excreta per pound
	Foreign Matter	Average of 1% or more pickings and swiftings by weight

Western Europe generally follows the grade specifications of exporting countries for spices for consumption. However, certain countries like Germany, the Netherlands and the UK have prescribed specific limits for pesticide residues, aflatoxin, salmonella, etc., which are considered stricter than those in other European countries. In Europe, Germany has instituted the strictest specifications. A common standard for spices imported by these countries may now be established through the European Common Market, considering the following quality factors:

Size, off-flavours, piperine content in pepper, non-volatile oil, insecticide residues, aflatoxin, dust and other foreign matters.

Table 9 below shows the parameters for white and black pepper which are followed by Germany.

TABLE 9

Quality Parameters Established in Germany for White and Black Pepper

	Black Pepper	**White Pepper**
Moisture	12% max.	15% max.
Volatile Oil	1.5% min.	1% min.
Total Ash	7% max.	3% max.
Acid Insoluble Ash	1.5% max.	0.3% max.
Pass through particle size	95% min.	95% min.
Sieve no.	16 (ground)	16 (ground)
	40 (unground)	40 (unground)

The permissable level of pesticide residue - aflatoxin, etc., is as follows:

Name of Chemical	**Max. Quantity in mg. per kg.**
DDT, UDE und deren	1 somere, Hept achlor-exopid
Hexachlorbenzol, Isobenzan, Isodrin	0.01
Chlordan, B-HCH, aber ohne Linden	0.02
Chlordan, DDT, UDE and deren Isomere Hexachlorbenzol	0.05
Aldrin, Endrin, einschlie Blich and Heptachlor, Hexachlorbenzol	0.1
HCH - Isomere	0.2

Aflatoxin levels earlier permitted have been reduced by a law enacted in May 1991.

From	B1 + B2 + G1 + G2	5 ppb/kg
	B1	10 ppb/kg
to	B1 + B2 + G1 + G2	2 ppb/kg

Importers will demand from the country of origin a certificate of analysis for aflatoxin for spices intended for Germany.

Quality complaints of spices are of recent origin and started coming out after the introduction of sophisticated testing procedures in importing countries. Black pepper has experienced the largest number of quality complaints, being the most popular spice in international rade. Complaints have concerned unsanitary handling of spices which create health hazards. Only the spice producing countries concerned are informed about these complaints in order to avoid embarrassment to them, so a comprehensive list about complaints is difficult to compile.

However, some of the quality problems which have been expressed by importing countries in international surveys about pepper are noted below:

- Bad odour and colour of white pepper (the Netherlands);
- Adulteration with cotton seed and contamination by filth (USA);
- Salmonella (USA and Germany);
- Mineral oil (Germany);
- High moisture (from Germany);
- High microbial count and pesticide residues (various countries);
- Mould in containers (UK);
- Excreta (USA);
- Large percentage of foreign matter (various countries).

["Changes in Quality Parameters of Spices", Item 7.3 of the Provisional Agenda for the Third Session of the International Spice Group, Kingston, Jamaica, 18-23 November 1991, International Trade Centre, UNCTAD/GATT, Commonwealth Secretariat, Doc. ISG3:8/91.].

2.3 TRENDS IN THE UTILISATION OF PIPER NIGRUM L

2.3.1 Volumes and Trends in Utilisation

The flavour industry will continue its high demand for pepper. Pharmaceutical uses are simply a spin-off and the demand for medicinal purposes is unlikely ever to affect the volume required by the flavour industry.

There will be a negligible additional cost to the flavour industry to extract/isolate the various useful components of pepper using the processes and technologies currently available. The flavour industry will absorb the cost of any product for pharmaceutical use while exploiting this use or by-product in some aspect of the flavour and related industries, e.g.,

perfumes, cosmetics, aerosols, etc.

Pepper is the most important spice in the international spice trade. Pepper imports have grown in the U.S., German, Japanese and certain Middle Eastern markets. The largest import demands come from North America and Western Europe. Import patterns are likely to alter with the widening of the European trade bloc, with the European Community demand for pepper greater than that of the USA. German demand for pepper is the greatest in Europe; it is second in the world after the USA. Saudi Arabia is increasing its demand for pepper, while Morocco, Algeria and Libya are significant importers also.

Produced mainly in Sarawak and more recently in Vietnam, pepper passes through Singapore to the main consumer markets. Singapore handles one-fifth of the pepper trade entering the international market. It provides quality services which importers require, and excellent communication, finance and shipping facilities. The emergence of new sources of pepper for this market, i.e. Vietnam and Thailand, will influence the spice trade further.

There has been an increase of 95% in pepper production in India due to planting on a large scale and adequate care of pepper plants. Pepper is 36% of India's total spice exports and has remained steady in the last three years. This year it is expected to export 36,000 MT.

Major concerns are that the detection of disease at farmer level is difficult and that the cost of measures necessary to stop the problem of "quick wilt" (Phytophthora) tends to discourage farmers from taking adequate care of crops, in view of current international prices for pepper.

Problems in developing the pepper market include the following:

a. Production statistics are difficult to obtain since small holder crops are cultivated in back gardens.

b. Pepper is influenced by climatic conditions, hence it is susceptible to sizeable variations in price from year to year. Export statistics equal production data.

European imports of pepper have grown due to:

- rising incomes which are sustaining the growth of demand,
- immigration/travel which are increasing interest in foreign cooking, much of which includes pepper,
- television/radio ads and increased leisure time, which affect the demand for herbs and products required for ethnic/exotic food,
- pepper's extensive use as a natural preservative,
- the growing trend in Europe towards foods low in sugar and salt, which has led to a search for alternative flavourings like pepper,

- the fact that pepper is free from artificial colouring and preservatives, and
- ethnic and culinary herb display units are increasingly common in food stores, which inform customers of uses for pepper.

2.3.2 Growth Trends and Future Development Potential

There is no current significant growth in either the herbal or pharmaceutical market, nor is it expected for the next five years. In ten years' time, there will be a slight increase in growth, however it will be insignificant compared with the growing volume of pepper needed for an expanding flavour industry.

This expansion is stressed in Tan Seok Lee's paper **[Appendix 4]**, which states: "China presently has a per capita consumption of only ten grammes of pepper per annum compared to 119 grammes and 117 grammes respectively for Hong Kong and Brunei. If the per capita consumption in China increases by a mere one gramme, it would mean that China had to import or increase by 1,200 metric tonnes per year. This scenario is also applicable to countries such as the Philippines and Indonesia which presently have a low per capita consumption of 15 grammes and 26 grammes respectively. Furthermore, the article states, "Singapore companies will also be encouraged to add more value to their spice trade. For example, we hear of opportunities to manufacture value-added pepper products such as pepper perfume, medicated pepper rub, pepper oleo-resin, pepper air-freshener with germicidal functions, etc."

Countries which produce/export spices are developing a more coordinated approach to production systems. They are engaging in bulk buying and sharing resources, e.g., mechanical implements. Nucleus farming is also more common. Foreign and private investment are increasing. Countries are also establishing boards to promote marketing of commodities and to improve quality control and coordination.

Importing countries are developing direct contact between importers and industrial users. More companies have dual roles, i.e., some importers grind spices and sell them wholesale and some grinders have become wholesalers.

The widening of the European trade bloc is likely to change import patterns in future. At present, the former socialist countries of Eastern Europe import significant quantities of pepper from India. Middle Eastern countries, notably Saudi Arabia, account for considerable imports of pepper. Morocco, Algeria and Libya are also significant importers and are usually price responsive.

New sources for pepper are also emerging. For example, Vietnam and Thailand are exporting pepper now. This will influence the spice trade overall as well as the pepper market.

2.4 POTENTIAL USES OF PEPPER AND PEPPER ISOLATES/CURRENT RESEARCH AND DEVELOPMENT FOR PEPPER AND PEPPER EXTRACTS

2.4.1 Development of Potential Uses

While scientific evidence for the reported health promoting properties of many spices is still lacking, the beneficial effects of certain spices are increasingly being documented. Products containing spices are familiar items in modern pharmacies and health stores. Further research is required to substantiate claims made for spices which have been traditionally used for health promoting properties.

The carminative properties of Piper nigrum have been valued since antiquity. In the Ayurvedic system of therapeutics, excess gas in the body is symptomatic of bodily disorder or "imbalance" and certain spices, like pepper, have been valued for their carminative properties in many civilisations. "Carminative" is defined as "expelling gas from the body" and flatulence or excessive gas in the alimentary tract is characteristic of many health disorders. Flatulence can also cause pain and discomfort in other parts of the body and it is often mistaken for the onset of a heart attack with the accompanying stress such a supposition induces.

Spices in general affect many functional processes, including salivary flow and the secretion of enzymes like amylase, which is essential for the proper digestion of starch; stimulation of its secretion makes foods rich in carbohydrates easier to digest. It is possible to arrange spices according to their amylase activity as follows: chilli, curry powder, ginger, capsicum, pepper and mustard.

While spices are traditionally prohibited to sufferers of peptic ulcers, some like pepper, are considered to be digestive aids. Pepper has a long reputation as a digestive aid and is good for gastro-intestinal upsets and flatulence.

There is a current movement towards natural, organic health supplements and medicines as substitutes for synthesised chemical drugs. The active, health-promoting properties of spices (including pepper) are being increasingly documented, but continued research is needed in this field to confirm their reported attributes. It is also necessary to investigate the possibility of any adverse side effects associated with using certain spices as health supplements and to establish effective dosage levels.

Current reservations about the use of coal-tar dyes as colourants, particularly in foods and cosmetics, also indicate the necessity of investigating the economic feasibility of extracting natural colourants from spices.

["Spices in Health Foods and as Colourants", Item 8.5 of Provisional Agenda, Doc: (SG3.18/91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

New medicinal uses may well result from the combination of academic research and developments in extracting pepper initiated by the flavour industry for its own interests.

Possible uses being developed are using pepper as an antimicrobial (antibacterial and antifungal), antifungal (including HIV), antiprotozoal and anticancer agent.

Four isolates from the Tincture of Pepper (currently available commercially, principally for the "drinks" industry) showed equal activity against nine strains of Mycobacterium tuberculosis (which is another germicidal use for pepper). Piperine was identified in the isolates by co-chromatography and is regarded as the active compound. [P.J. Houghton, A. Astaniou, J. M. Grange and M. Yates, J., Pharm. & Pharmacol., 1994, 46 Supplement 2, 1042.] Dr. M. D. Yates of the Public Health Laboratory Service (Regional TB Centre, Dulwich Hospital, East Dulwich Grove, London, SE11, UK, Tel.: 0181 693-2830) has developed a method for the rapid screening of many plant extracts for activity against M. tuberculosis. This has been published in: Telles M.A.S., Yates M.D. (1994) Tubercle and Lung Disease 75, 286-290. **[Appendix 5:** "Antibacterial Activity of Extracts and Constituents of Piper Nigrum and Galipea Officinalis.]

This development from pepper and pepper extracts could be very important commercially. At present, an expensive cocktail of synthetic compounds (such as Rifampicin, Rifabutin, Isoniazid, Ethambutol, Pyrazinamide and Catreomycin) is used to try and control the spread of TB in the USA and other parts of the world with growing populations of peoples with limited means of supporting themselves, as well as those with the AID Syndrome. The labour costs involved in ensuring compliance of the dosage regime with the cocktail is an additional high cost, therefore the use of pepper could be most important.

Both aqueous and ethanolic extracts (tinctures) -- which contain Piperine, etc. -- of fruits of Piper nigrum have exhibited high activity against a Penicillin resistent strain of Staphylococcus aureaus growth in an agar well diffusion test method. [Perez, C. and Anesini, C., "Antibacterial Activity of Alimentary Plants Against Staphylococcus aureus Growth", American Journal of Chinese Medicine, 1995, 22 (2), pp. 169-174 (En, 9 ref.).] This is another example of the antibacterial activity which may be derived from pepper. It is at an academic stage and will take up to ten years for development to an "approved" stage.

There is currently a demand for naturally-occurring antifungal agents for use in agriculture and the food industry and P. nigrum is being investigated for this purpose. Some examples are:-

Benzene extracts (which will contain Piperine, etc.) of P. nigrum have shown activity against the mycelial growth of sclerotia-forming fungal pathogens of Sclerotium rolfsii [Corticium rolfsii], Rhizoctonia solani and Sclerotinia selerotiorum. [Chaudhuri, T. and Sen, C., Zeitschrift fur Planzenkrankheiten und Pflanzenschutz, 1982, 89 (10), pp. 582-585 (En, de 7 ref.]

Of 31 extracts, maximum inhibition of Drechslera oryzae in rice was shown by extracts of peppermint leaves, followed by P. nigrum "seed" (meaning fruit) and garlic extract [Alice, D. and Rao, A.V., International Rice Research Newsletter, 1987, 12 (2) 28 (En)].

P. nigrum essential oil was included in antifungal studies by Jain, S.R. and Jain, M.R., in Planta Medica, 1972, 22 (2), pp. 136-139 (En, 7 ref.). It showed good antifungal activity in general against (Culvularia) lunata (Cochliobolus lunatus), Rhizopus, spp., Aspergillus spp.

and Penicillium spp. Chaurasta, S.C., and Kher, A., Indian J. Hosp. Pharm., 1978, 15 (5), pp. 139-141 [En, 11 ref.).

Of crude aqueous (as distinct from oil in last paragraph) extracts of 127 plant species, P. nigrum extract was the most inhibitory to Rhizoctonia-like isolate #8. [Garcia, R.P. and Lawa, M.V.P., Philippine Agriculturist, 1990, 73 (3-4), pp. 343-348 (En, 9 ref.)].

Furthermore, antiprotozoal properties have been shown in extracts of the fruits of P. nigrum [Agarwal, A.K. et al., Journal of Ethnopharmacology, 1994, 44 (3), p. 8 (En, 8 ref.)].

Pepper oil is not recommended for the control of gram-negative bacterium - Aeromonas hydrophila in cooked meat (essential oils of Coriander or Clove are recommended). [Stecchini, M.L. and Sarais, I., and Giavedoni, P., "Effect of Essential Oils on Aeromonas hydrophila in a Culture medium and in Cooked Port", Journal of Food Protection, 1993, 56 (5), pp. 406-409 (En, 21 ref.)].

However, other extractives of the fruits of P. nigrum might well prove to have the desired activity for preserving cooked meat, in view of the foregoing antibacterial (germicidal) activity reports.

The activity of Piperine and its four different geometrical isomers -- Piperine (the E.E. form), Chavicine (the Z.Z. form), Isochavicine (the E.Z. form), and Isopiperine (the Z.E. form) -- could well be improved by the selection of the most active isomers from the mixture for a particular purpose. The mixture is readily available through the use of carbon dioxide as the solvent in the extraction of pepper fruits. Methods for isolating individual isomers are also available. Universal Flavours plc, for example, have the "know-how".

Piperidic acid (GABA; gamma-Aminobutyric acid) is an inhibitory transmitter at the neuromuscular junction in the central nervous system which has been used to treat cerebral disorders, including coma, and is hypertensive. [Phytochemical Dictionary, ed. J.B. Harborne and H. Baxter, publ. Taylor & Francis, London, 1993, ISBN 0-85066-736-4.]

Other species of Piper are revealing new activities which may also be available from Piper nigrum. R.E. Schultes has studied the plants of the Amazon, notably for their value in the treatment of the elderly (an area receiving much attention from the pharmaceutical industry).

For those "who sit staring into space all day", he recommends an infusion of P. schultasii [Ciba Foundation Symposium 185, "Ethnobotany and the Search for New Drugs", published by John Wiley & Sons Ltd., Chichester, 1994, ISBN 0 471 95024 6, page 169].

Another example of antiprotozoal properties is that of Piper longum (Pippali) with Butea monosperma (Palash) in an Ayurvedic medicine, Pippali rasayana, for the management of giardiasis by an immuno-modulatory activity [Agarwal, A.K. et al., Journal of Ethnopharmacology, 1994, 44 (3), pp. 143-146 (En, 8 ref.)].

2.4.2 Development of Spice Processing Technology

Modern milling technologies, including cryomilling, centrifugal, selective grinding and cold-milling systems, are being developed. Other technologies include super-critical fluid extract technology (SFE), the use of CO2 for insect disinfestation, spice irradiation, steri-spices, micro-encapsulation, and the application of bio-technology for the development of better-quality spices suitable for processing and flavour manufacture, etc.

There is also development in the production of value-added spice products, different types of spice extractives, essential oils, oleoresins of different types, aquaresins, concentrates, bake-resins, liquid spices, spice concentrates, absolutes, essences and numerous other new products. By-products are also being developed from industrial wastes from about a dozen spices.

["Developments in Spice Processing Technology", Item 7.2, Doc. ISG3:7/91, of the Provisional Agenda for the Third Session of the International Spice Group at Kingston, Jamaica, 18-23 November 1991, International Trade Centre, UNCTAD/GATT and Commonwealth Secretariat.]

2.4.3 Development of Spices as Flavours

Spices have tended to be regarded as "auxiliaries" in the flavour industry, however today this is changing due to better presentation, quality control and production techniques. They are now being marketed as natural flavours.

Now that modern techniques and the advent of gas chromatography, especially High Performance Liquid Chromatography (HPLC) for determining pungent compounds, spices may more easily be proven to be pure and unadulterated by other substances. The whole spice, however, provided that it has been picked and shipped correctly, has a flavour that is superior to that of ground and other processed spices. Ground spice is open for criticism concerning contamination, burning during grinding and exposure to evaporation, oxidation and moisture; cryogenic grinding defeats the burning and caking on rollers. Good handling is necessary in transporting spices, as is good packaging, in order to avoid contamination.

"The struck on flavours on salt, starch or dextrose with a trace of anticaking agents are advocated as being of constant uniform strength and quality, sterile, easily handled in sound packaging, [and] delivered readily, thus reducing stock holding."

Formulated from oleo-resin, they are usually fortified with more volatile oil to replace the missing top note. Being manufactured, they immediately are identified as not being as good as natural material their biggest advantage being quality assurance, their biggest problems the added-on value of manufacture the sales profit necessary for a flavour house and shelf life". Encapsulated flavours have the same advantages of life. They suffer from the same problems apart from the worry about shelf-life. They are ideal for dry mixes like packet soups.

Essential oils have the advantage and disadvantage of concentration, which is difficult to control, while the biggest problem regarding oleoresins (which should be treated like

essential oils) can be the quality and quantity of solvents used in their production. Carbon dioxide extracted oils have the same advantages and disadvantages associated with essential oils, and the production plant is expensive so there are very few in existence.

Sterilization, or lack of it, is also a consideration in marketing spices. Irradiation for this purpose, for example, may not be wholly acceptable to the consumers.

Today good equipment, know how and analytical techniques are available for producing essential oils and oleoresins in the country where the spices are grown. The producer may utilise the wastes from raw materials for essential oils.

There is already present a ready labour force that can be utilised when other farm and packing activities are quiet. Transportation costs are negligible. By burning residues from the materials, there can be an ample supply of cheap steam. The entire process of growing and producing spices may be controlled by the producer.

["Spices as Flavours", Item 8.2, Doc. ISG3:15/91, of the Provisional Agenda for the Third Session of the International Spice Group at Kingston, Jamaica, 18-23 November 1991, International Trade Centre, UNCTAD/GATT and Commonwealth Secretariat.]

2.5 PEPPER EXTRACTS/ISOLATES

2.5.1 Types of Pepper Extracts/Isolates

(1) Black Pepper Oil

Black pepper yields 1.5% of volatile oil. This has a warm flavour, is sweetly spicy, woody, fruity and musty with a pleasantly warm after taste. It is primarily a mixture of hydrocarbons and consists of 70-80% monoterpenes, 20-30% sesquiterpenes and less than 4% oxygenated compounds.

(2) Pepper Oleoresin

Pepper oleoresin possesses the odour, flavour and pungent principles of the spice. The pepper is comminuted in flakes of 0.05mm thickness or ground into coarse powder measuring 0.1 to 0.3mm in diameter, then extracted using organic solvents such as acetone, ethanol or dichloroethane. The extraction is done by one of several methods - by circulation of hot or cold solvent through a bed of ground spice or a method based on the Soxhlet extracton or by a concurrent process employing several extractors. The concentrated extract is then subjected to controlled vacuum distillation in which the solvent in the extract is reduced to trace levels. Normal yields from black pepper are about 6% but oleoresin yields of 10% to 13% have been reported from Indian Malabar pepper (Nambudri et al., 1970). The fresh pepper oleoresin is a dark green viscous heavy liquid with a strong aroma which on standing produces crystals of piperine.

The two principle grades of oleoresin are Indian decolourised and Indian non-colourised. The decolourised product is a light yellow green semi-solid and contains 55% piperine and 20 ml. of volatile oil per 100g; the non-decolourised product is a deep green

semi-solid containing 53-57% piperine and 23-30 ml. of volatile oil per 100g.

The importance of oleoresin can be demonstrated by the fact that 1 kg. of the substance obtained from 8 kg. of black pepper can replace 25 kg. of the natural spice for flavouring purposes.

Until recently pepper oleoresin was manufactured only in the highly industrialised countries such as the USA and the UK, but nowadays with western co-operation, processing is carried out in India, Singapore and Indonesia.

(3) Piperine

Piperine is prepared by treating the solvent free residue from an alcoholic extract of black pepper with a solution of sodium hydroxide, which combines with the resin leaving the alkaloid behind.

(4) Piplartine (Piperlongumine)

Piplartine is a pyridine alkaloid found in the roots of Piper longum and P. sylvaticum (different species from Piper nigrum L). It is reported to be effective for the treatment of asthma and chronic bronchitis. [Phytochemical Dictionary, edited by Jeffrey B. Harborne and Herbert Baxter, published by Taylor & Francis, London, 1993, ISBN 0-85066-736-4.]

(5) Sabinene

Sabinene, which is reported in the GLC data [**Appendix 2**: Moyler, D.A.; Browning, R.M.; and Stephens, M.A., "Ten Years of Carbon Dioxide Oils", Proc. 12th ICEOFF, Vienna, 1992, pp. 52-100, ISBN 3-95001-82-1-2.], is said to occur in Sri Lankan pepper oil and to be absent from Indian pepper oil [McCarron, M.; Mills, A.; Whittaker, D.; Kurian, T.; Verghese, J.,"Comparison Between Green and Black Pepper Oils From Piper nigrum L. Berries of Indian and Sri Lankan Origin", Flavour and Fragrance Journal, 1995, 10 (1), pp. 47-50 (En. 22 ref)].

2.5.2 Properties of Piperine and Some Piperine Derivatives

Like many other compounds, e.g. nicotine, steroids or non-steroidal anti-inflammatory agents, Piperine and its analogues can be absorbed through the skin. Research into Piperine is not commercial yet, and is dominated by the food/flavour industry.

Piperine enhances the bioavailability of many drugs, e.g. ampicillin, and also synthetic drugs. It increases absorption substantively and is a useful antipileptic.

Lesley Bremness, in her book World of Herbs, published by Ebury Press, London, 1990, ISBN 0-85223-821-5, states in the Aromatherapy section entitled "Pepper Black (Piper nigrum)": "This is a warming oil which brings the blood to the surface, stimulating circulation. It is used to treat coughs, colds, high temperatures and muscular aches and pains. [This indicates that it is active as a germicide and is absorbed by the skin.] It is also employed to treat disorders of the digestive tract."

In the West, the reliability of piperine and piperine derivatives in synthesis with other natural plant extracts in use as antihelminthics and anti-inflammatories is disputed. However, elsewhere, e.g. as in South East Asia, their reliabiity is accepted as traditional medicine.

2.5.3 Methods Used for Extracting/Isolating Pepper

Extraction methods/processes used include:

- traditional solvent extraction,
- supercritical fluid extraction (SFE),
- carbon dioxide,
- steam distillation, and
- gas chromatography.

The base and powder are produced by dry reduction milling of dried peppercorns through using conventional pepper milling equipment.

Extracts are prepared by drying and milling berries to prepare the material, followed by extraction using a solvent. Dry extracts are produced by evaporating the solvent before packaging the extract.

Extracts for pharmaceutical use are based on propylene glycol or ethanol. Very few pepper extracts exist, but one which we have identified is manufactured by Chemische Fabrik Dr. Hetterich in Furth, Germany. This is called Extractum Piperis nigri 1:5 and is based on 60% ethanol. This means that 1 kg of extract is made from 5 kg of dried berries.

Pepper essential oil is prepared by conventional steam distillation of sun dried berries. High drying temperatures can reduce the essential oil content of the berries before distillation and should be avoided. Dried berries are placed in a distillation tub, steam is passed through, the distillate is recondensed and the oil fraction is separated from the water to produce the essential oil.

Most commercial pepper oil is produced in Western Europe and North America from imported Lampong and Malabar black pepper. Malabar black pepper has a slightly higher oil content than Lampong pepper. To extract the essential oil, the pepper is crushed to a coarse powder and then steam-distilled.

The distillate is 1% - 2.6% of a colourless to a pale green essential oil (Gildemeister & Hoffman, 1956) with a mild non-pungent flavour. It is a mobile liquid which becomes viscous on ageing. Since pepper oil possesses the aroma and flavour of the spice without its pungency, it is used in food flavouring, perfumery and Aromatherapy.

Black pepper oils obtained by vacuum distillation of oleoresins are thought to be closer in composition, aroma and flavour to the natural oil present in the spice than that obtained by steam distillation, as shown by comparative work done by Lewis et al. (1969) and Richard et al. (1971) who independently screened seventeen different cultivars grown in Kerala.

Oils obtained by vacuum distillation of oleoresin extracts differ from that obtained by steam distillation of the spice by containing less monoterpene hydrocarbons, considerably more sesquiterpenes and oxygenated compounds (Richard, 1972; Biserle & Rogers, 1972; Salzer, 1975).

Various methods of extraction are used for plant derived raw materials. They include:

(1) Supercritical Fluid Extraction (SFE)

The most versatile separation technology now being developed is Supercritical Fluid Extraction. It has a high extraction selectivity from a mixture of components because of the pressure-temperature dependent solubility in the solvents. It can extract components from dry pepper or from its essential oils.

The pepper raw material is loaded into the extractor and brought into contact with the supercritical solvent at relatively high pressures, ranging from 80-350 bar, at temperatures of 35-70 degrees centigrade. The solute mixes into the supercritical solvent and both are passed through a pressure reducing valve. The pressure on the separator side is about 40-60 bar while the temperature is lower due to sudden expansion of the supercritical solvent. These conditions lower the solubility of the pepper raw materials in the solvent. When the material starts to separate, the gas is again compressed back to extract the material. Solvent recycling is achieved by means of a compressor.

Supercritical carbon dioxide is an ideal solvent for extraction of pepper, because it is cheap, abundant, inert, non-toxic, non-corrosive, non-inflammable and does not pollute the environment. Separation can be carried out at low temperature, residual solvent content can be reduced to near zero, solubility variation of active constituents can be easily manipulated, fractions can be extracted easily, the process consumes little energy, transfer rates are high and there are no fire hazards.

Pepper extraction has been very successful, with almost 98% extraction of Piperine and 81% of essential oil. Pepper has also been extracted for Pepper Oleoresin using supercritical carbon dioxide.

Compared to the conventional two stage milling and steam distillation process, supercritical fluid extraction using carbon dioxide produces a higher quality product with higher essential oil and piperine contents. The new process should be economically viable for production of raw materials for use in the pharmaceutical industry.

(2) Percolation

The simple percolation process for producing tinctures (i.e. extraction with aqueous ethanol) is now carried out also by "pump percolation". (A "tincture" is often the product preferred by the "drinks" section of the flavour market.)

(3) Oleoresin Extraction

Oleoresin extraction (by, e.g., acetone) is commonly practised, but in removing acetone towards the end of the process, terpenes come over and can be added to pepper oil but also kept as a terpene fraction and further fractionated for a variety of uses. The oleoresin is adjusted to contain, e.g. piperine 40% and oil 20% for the flavour industry.

(4) Steam Distillation

Steam distillation is still the main process for the production of the volatile/essential oil of pepper. Some companies in the West have abandoned this process, preferring to purchase steam-distilled cheap oil from their subsidiaries in the country of origin, e.g., H.E. Daniel of Tunbridge Wells from their company in India.

(5) Carbon Dioxide Extraction

Carbon dioxide as a solvent for extraction of pepper is now used under a wide range of conditions to produce "carbon dioxide black pepper oil", which has advantages over steam distilled oil in that no extra terpenes are generated during the process. **[Appendix 1.]**

A variety of other extracts, some of which can have a very high concentration of crystalline piperine, are also available by carbon dioxide extraction under a range of conditions. Mr. David Moyler of H.E. Daniel Ltd. has kindly supplied some of his published information **[Appendix 2**: Moyler, D.A.; Browning, R.M.; and Stephens, M.A., "Ten Years of Carbon Dioxide Oils", Proc. 12th ICEOFF, Vienna, 1992, pp. 52-100 -- see Figures 20-23, pp. 78-9 and 98. ISBN 3-95001-82-1-2]. This includes a comparison of pepper oil obtained by using carbon dioxide as a solvent and by steam distillation, and offers the composition of these oils, revealed by GLC.

(6) Refrigerant Fluids

Experiments for a new method utilising refrigerant fluid are being conducted by Peter Wilde at Advanced Phytonics, UK. [For the above section, note Dr. Hardman's information in **Appendix 1** of this report.]

2.5.4 Costs of Extraction

There will be a negligible additional cost to the flavour industry for extracting/isolating the various useful components in pepper using the technologies currently available. It will absorb the cost of any product for pharmaceutical use while exploiting this use or by-product in some aspect of the flavour and related industries, e.g., perfumes, cosmetics, aerosols, etc.

In determining the costs of extraction, Dr. Hardman suggests that the reliability of the process or technology employed for extraction and isolation/separation will be of primary importance. The quality of the technology/process will be of secondary importance, followed by its efficiency, the quantity of processes employed, its cost and speed.

The equipment available for the extraction of pepper for use in the flavour industry and the associated facilities of its research and development departments should be adequate for the purpose, according to Dr. Hardman. [Section 3.2 of this report.]

Sigma Chemical, Fancy Road, Poole, Dorset, BH17 7BR, Tel.: 0800 447788, Fax: 01202 715460, offer "Piperine" in their 1995 catalogue at £50.50 for 25g. The other isomers are not listed. Piperidine is priced at £39.70 for one litre. They also supply many piperidine salts, the most expensive of which is "Piperidine-4-sulfonic acid" (a specific GABA/gamma-Aminobutyric acid agonist) at <156>176.20 for 250 mg.

Investment and Plant Operating Costs

Investments vary according to the size and type of plant purchased, but some average costs are given here for comparative purposes:

Drying Plant	£300,000
Extract Plant	£900,000
Essential Oil Distillation Plant	£100,000

Hourly plant operating costs are similar for all three processes and cost about £20/hour. However, seed would probably be sun dried as this is far cheaper. Pepper milling plants probably already exist in most pepper growing areas, so new investment would not be necessary.

The flavour industry will absorb the negligible additional cost of any product for pharmaceutical use while exploiting this use or by-product in some aspect of the flavour and related industries, e.g., perfumes, cosmetics, aerosols, etc.

Capital outlay for SFE is much higher, as are its quality and speed, but the running costs of solvent extraction are much higher. These extracts' efficacy obviously depends upon the conditions in which they are used.

Table 10 below shows the average percentage mark-up for various types of plant and raw materials used in cosmetic and pharmaceutical products. It demonstrates the opportunities to the producer for adding value to plant raw materials and for use in these industries. Aqueous and glycolic extracts are mainly used in the production of cosmetics and alcoholic and dry extracts in the production of pharmaceuticals. The mark-ups for essential oils are even larger at 5-10,000%. These figures are averages for many plant species and are only indicative for pepper.

TABLE 10

Index Values and Percentage Mark-ups of Plant Raw Materials in Germany and France 1994/5

	Base	Aquéous Extracts	Glycolic Extracts	Alcoholic Extracts	Dry Extracts	Tinctures
Average Index	100	251	287	526	1,931	357
% Mark-up	-	151	187	426	1,831	257

2.5.5 Recent Advances in Processes Towards Future Development

Economically viable innovations are known to constitute the backbone of success for any industry, as long as the innovations are the offspring of systematic, well-planned and well-coordinated scientific and technological research in the concerned area of discipline. This applies equally well to spice processing technology.

2.5.6 Future Developments for Extract Production

The cost could be decreased if cheaper methods of extraction are found. New methods for extracting oils are expected and more uses found for pepper, which will increase the amount required in the marketplace.

2.5.7 Potential Uses/Research and Development for Pepper and Pepper Extracts

New medicinal uses may well result from the combination of academic research and developments in extracting pepper initiated by the flavour industry for its own interests. At the academic stage of research are studies on pepper used as antimicrobial (antibacterial and antifungal), antiviral (including HIV), antiprotozoal and anticancer agents, etc. It will take at least ten years for these new medicinal uses to be developed. However, in those areas of the world where the use of crude extracts of medicinal and aromatic plants can gain approval for medicinal use, e.g., South East Asia, the time for placing such a product on the open market could be five years.

2.6 SCIENTIFIC OPINION OF THE PROPERTIES OF PEPPER

2.6.1 Pharmacological Actions

Black pepper is an acrid, pungent carminative and antiperiodic. Externally it is used as a rubefaciant and skin stimulant. The oleoresin and essential oil are reported to be antibacterial and antifungal. The fruits also exhibit taenicidal activity.

Black pepper oil warms the skin and brings blood to the surface, stimulating circulation. Effects of piper on the nervous system ["Plantes A Action Tonifiante et Stimulante

Chez les Yoruba en Afrique et au Bresil", Verger, P., Anthony, M., Ethnopharmacologie: Sources, Methods, Objectifs, Metz 22-24 mars 1990, pp. 452-3.] and on sexual organs (priapism) [Materia medica, Voisin] could indicate anticonvulsive and vasodilatoral properties. INIST (a data bank on natural products and plants) **[Appendix 6]** offers two references on its cardiovascular effects and biological activities in mammalian systems. Piper nigrum has an effect upon lactation [Materia medica, Voisin]. It is also used in Ayurvedic formulations for heart disease **[Appendix 7:** "Surveying of Sanskrit Medical Texts for Cardiological Information", Kumar, D.S., and Prabhakar, Y.S., Ethnopharmacologie: Sources, Methodes, Objectifs, Metz 22-25, mars 1990, pp. 182-3.]

[Above information obtained from Dolisos Laboratoires, Paris, France.]

Piperine, the active alkaloid, has been shown in experiments with rats to be an anticonvulsant. Piperine is said to have antiepileptic properties in therapeutic use and to enhance the bioavailability of many drugs, including ampicillin and synthetic ones, by increasing absorption substantively. It is also an analeptic; antinarcotic; antipyretic; antiseptic; bactericide; cancer preventive; cardiotonic; carminative; CNS-stimulant; hepatoregenerative; hypotensive (1mg per kg iv dog); hypertensive; insecticide; insectifuge; mutagenic; myocontractor; myorelaxant; spasmolytic; spermogenic; and a stimulant. [Handbook of Biologically Active Phytochemicals and Their Activities, p. 132.]

Piperidine is noted as a CNS-depressant; insectifuge; spinoconvulsant and urate solvent (Ref. as above).

Piper nigrum amides have also been shown to have insecticidal properties. (Agricultural and Food Chemistry, 1981, Vol. 29, No. 1, pp. 115-118.)

2.6.2 Clinical and Toxicological Studies

Anticonvulsive, vasodilatory, antihelminthic and anti-inflammatory activities have not been reported in the pharmacology index of The Review of Aromatic and Medicinal Plants, Ed.: D. J. Cousins, CAB International, Wallingford, 1995, ISSN 1356-1421, Volume I, Nos. 1, 2, 3 and 4.

(1) Antibacterial Activities

Other sources note that the essential oil of P. nigrum acts as an antibacterial (Jain & Kar, 1971; Rao & Nigam, 1976) and antifungal (Jain & Jain, 1972). Aqueous, ethereal and ethanol extracts of Piper nigrum fruits were reported to have taenicidal activity and were significantly effective against cestodes but not against trematodes. Haxane extract exhibited very good larvicidal action against the mosquite culex fatigans (Deshmukh et al, 1982). P. nigrum fruits were devoid of an significant hypoglycaemic action in rabbits (Tripathi et al, 1979). [Medicinal Plants of India, Vol. II, ICMR, New Delhi, 1987, p. 428.]

(2) Aromatherapy

The Aromatherapy Charts **[Table 1]** of t[illegible] report indicate toxicity and contraindications, naming some of the relevant compounds. Alpha-Phellandrene occurs in oil of pepper as the (+) form (also in oil of fennel and as the (-) form in other oils, e.g., eucalyptus oil). Harborne and Baxter [Phytochemical Dictionary, ed. Harborne, J.B.; Baxter, H.; publ. Taylor and Francis, London, 1993, ISBN 0-85066-736-4.] say this compound "can be irritating to, and absorbed through, the skin. Ingestion can cause vomiting and/or diarrhoea. It is used in perfumery."

D. A. Moyler et al (Proc 12th ICEOFF, Vienna, 1992, pp. 52-100) **[Appendix 2**, page 2.] mentions that all carbon dioxide extracted black pepper oils must be carefully fractionated to remove all of the piperine homologues and resinoid components for skin contact fragrances. When applied to the skin, these cause irritation. Piperine and its homologues are removed because they are absorbed through the skin, so that there is no skin reddening.

(3) Homeopathy

No useful clinical or pharmacological researches have been done in homeopathy since the first pathogenesia conducted by Houat in 186[illegible], according to Dr. Pierre Dorfman of Dolisos Laboratoires of France.

No toxicological studies have been performed because the concentration of pepper used is very low.

(4) Piper Cubeba

In the West, the fruits of Piper cubeba have been preferred to those of P. nigrum. The medicinal uses of the fruits of P. cubeba are described as aromatic, diuretic, expectorant, carminative and are used for bronchitis, coughs and urinary tract infections.

The ground fruits have been found to be effective in treating amoebic dysentery. The oil is reputedly antiviral in rats and antibacterial in vitro. The British Pharmaceutical Codex 1949 included doses for Cubeb Oleoresin, Oil and Tincture. Potter's (Herbal Supplies) Limited of Wigan probably still supply an Asthma and Chest Mixture based on Cubeb.

(5) Piplartine (Piperlongumine)

Piplartine (Piperlongumine), a pyridine alkaloid found in the roots of Piper longum and P. sylvaticum, is reported to be effective for the treatment of asthma and chronic bronchitis. [Phytochemical Dictionary, edited by Jeffrey B. Harborne and Herbert Baxter, published by Taylor & Francis, London, 1993, ISBN 0-85066-736-4.]

3. CONCLUSIONS

3.1 SUMMARY OF INTERVIEWS WITH PHARMACEUTICAL AND HERBAL COMPANIES

When Piper nigrum L is utilised, very small quantities are used. Not many companies appear to use it as it is considered too abrasive for most products. Apart from the food/drinks/flavour industry, it is frequently used in small quantities in the form of Black Pepper Oil for fragrances.

Estimated volume of use is only about 50 tonnes per annum at the most.

[**Appendix 8** for an example of replies received to our questionnaire.]

3.2 SUMMARY OF INTERVIEWS WITH PHARMACOLOGISTS

Piper nigrum L, used throughout the world as a condiment, is utilised to a very small extent in the forms of essential oil and oleoresin in the pharmaceutical and herbal medical industries. The need for it in pharmaceutical and herbal medicines is negligible compared to the rising demands of the flavour industry. Its activities tend to be taken more seriously by traditional medicine practitioners, especially those of South East Asia.

However, new medicinal uses may well result from the combination of academic research and developments in extracting pepper initiated by the flavour industry. The summary of information from pharmacologists has been included in this report and may be found in **Appendix 1**.

3.3 SAMPLE OF INTERVIEWS WITH UNIVERSITY SPECIALISTS

Sample interviews from the following may be found in **Appendix 9** of this report:

Questionnaire answered by:

Brian Lockwood, BPharm, PhD, MRPharmS, Legal and Commercial Consultant, Department of Pharmacy, The University of Manchester.

Questionnaire answered by:

Dr. M. Aslam, LLM MSc PhD FRPharmS MCPP, Course Director in Clinical Pharmacy. University of Nottingham.

3.4 SUMMARY OF DATABASE RESEARCH

(**Appendix 12** for Medical and other Database Information on pepper).

Below is a summary by Dr. Hardman of the detailed references from BIDS EMBASE Database Information, obtained by Dr. Amala Raman, Lecturer in Pharmacognosy, King's

College London. Figures refer to record numbers and the year, in **Appendix 12**.

BLACK PEPPER - Piper nigrum

Cultivation

The result of source removal on the developing spike of black pepper has been studied (58, 1984). The effect of post harvest drying on the blackening of pepper has been reported (65, 1983) and other drying studies on black pepper have been undertaken (39, 1989). A low dose of 2, 4-D has been used to promote fruit development (57, 1985). Application of lime reflectant on the leaves of black pepper has been used to prevent loss of photoinduced chlorophyll (56 1985). Foliar nutrient levels and their effect on the yield in India have been described (38, 1989). Biofertilisers and their effect on growth in India has been reported (37, 1989). Five varieties of pepper were studied for their light saturation level on live standards in India; Cv. Panniyoor 1 was found to be the best (21, 1991). The diazotroph, axospirillum, has been used to induce rooting of pepper cuttings (52, 1985). Aminoglycoside antibiotics have facilitated the micropropagation of P nigrum cv Kuching leading to shoot development (16, 1992). A study of three pollarded leguminous trees Erythrina berteroana, E fusca and Gliricidia sepium as live supports for black pepper and contributions from their prinings to N, P and K needed by the pepper has been reported from Costa Rica in a region with a mean annual rainfall of 2460 mm (8, 1993). The productivity of pepper vines as influenced by light availability during the pre-flowering stage has been described from India (41, 1988). A "seed" moisture content of 12% has been recommended for storage for a minimum loss of viability (7, 1986).

Cultivation - Pests and Diseases

In India, a new endo-parasite, Trophotylenchulus-Floridensis-Raski has been reported (67, 1982). The relationship between mineral nutrition and slow wilt disease of pepper in India has been investigated (66, 1982). The changes in the protein content of the pepper fruit - as a result of fungal infestation in India have been recorded (60, 1983). In Sri Lanka, the little leaf disease of pepper has been described (59, 1984). From India has come the first report of Cylas formicarius F on black pepper (54, 1985).

A report from Switzerland has covered the leaf histology and leaf infection by Phytophthora palmivora (50, 1986). From India the effect of different insecticides on the control of the pollu beetle Longitarsus nigripennis Mots, a major pest, has been described (48, 1986). There is a new record of two species of flea beetle infesting leaves of pepper in India (47, 1987). Also from that country, has come a record of the damage by the insect Sahyadrassus malabaricus.

Moore on the support standard Gliricidia maculata (45, 1987). The incidence of foot rot in Kerala, India, in relation to cultivation practices has been recorded (36, 1989). On pepper a new report of infestation by white fly, Bemisis tabaci, has come from India (26, 1992) and another new report, also from India, of the pest Pterolophia griseovaris Breuning (19, 1991). The first report of the natural control of the larva of the top shoot borer Cydia hemidoxa Meyr by the nematode Haxamermis Sp (Dor-Mermithidae) has been recorded in India (10, 1994). The damage caused by this borer is also the subject of a paper from Kerala

(11, 1993).

Analytical

From Australia, the determination of piperine in pepper using high performance liquid chromatography has been described (64, 1983). From Canada, the determination of piperine in black and white pepper by liquid chromatographic method has been published (46, 1988). The analysis for sensory characters of the distilled oil compared to that obtained by supercritical gas extraction has been reported. Pepper odour was attributed only to the oxygen containing sesquiterpenoids - 2.8% in gas extracted material and less than 0.6% in the distilled oil. The non-volatile acid amides may contribute to the peppery taste of the supercritical gas extract (20, 1992). From Kenya, a headspace analytical procedure has been described for the comparison of the airborne volatiles from black pepper and banana pseudostem (Musa sp) (9, 1994).

Chemical Composition

Amides

From Japan the structure and synthesis of phenolic amides from P. nigrum have been described in three papers (72, 1980); (71, 1981); (69, 1981). Reference to the insecticidal properties of pepper amides has been made in a paper from the USA (72, 1981). In Canada, insecticidal unsaturated amides have been prepared, namely, Pipercide and Piperolein A in 21% and 35% yield respectively, by means of the aldol-Grob-type fragmentation sequence using propylene glycol. The norhomologues of these natural products were likewise prepared. Routes via the esters or the carboxylic acids are also given (4, 1994). From India, the pesticidal value of the steam distilled oil of black pepper is included in this general and wide ranging review of plant essential oils (12, 1993).

General

The accumulation pattern of the oleoresin and related constituents during the growth and development of the pepper berries has been described from India (68, 1981). The effect of maturity on some chemical constituents of Sri Lankan pepper has been reported (63, 1984).

The variation in the chemical constituents of green, black and white pepper from three cultivars growing in Australia has been described (61, 1984) and from the same group, the compositions of the oils from the same sources have been listed (53, 1985). The distribution of piperine in the vegetative parts of P. nigrum has been studied in Germany (44, 1988). Ligans have been isolated from the leaves of P. nigrum in India (42, 1988). Also from India, the physical chemical characteristics of the volatile oil extracted by supercritical carbon dioxide have been described (40, 1989). The phenolics of green (unripe) berries have been reported (India) (34, 1990). From Cuba, the chemical composition and sensory properties of black pepper oil has been documented (33, 1990). From the unripe green Indian fruits of six commercial varieties of pepper, the phenolic compounds, 3, 4-dihydroxyphenylethanol glucoside and 3, 4-dihydroxy-5-(N-ethyl amino) benzamide have been isolated and separated. These served as efficient substrates for pepper phenolase and showed a wide qualitative and quantitative variation in their composition within the varieties. An HPLC method was used,

employing 4-methylcatchol and epinephrine as external standards (2, 1994).

Food Industry

The commercial outlook for black pepper production has been examined in a pepper from The Netherlands (49, 1986).

Spice Industry

Decontamination of white pepper by ethylene oxide has been reported from a study made in France (55, 1985). (This method is no longer used). The effect of sterilisation by gamma radiation on prepackaged black and white pepper has been reported (29, 1991). A method is described for reducing the number of viable microorganisms on black pepper fruits using a temperature of 40 degrees centigrade and a hydrostatic pressure of up to 4,000 bar, without affecting the pungent taste (25, 1992). The effect of storage on the changes in sensory character of powdered pepper has been shown to be best evaluated by selecting 6 peaks from the 30 peaks of the oxygenated compounds obtained by a defined extraction and gas chromatographic procedure (23, 1992). In a recent study, it was found that the colour retention of fresh pepper was best achieved in microwave exposed boiling water blanched samples (18, 1992).

Toxicity

The use of the Egyptian toad Bufo regularis as a test animal has been recommended for the investigation of possible carcinogenicity of black pepper (43, 1988). Forced feeding of 50 male and 50 female Egyptian toads of extract of black pepper, 2mg, 3 times a week, for 5 months, caused tumours to arise after 2 months, with liver tumours in 12 males and 18 females and fetastatic deposits inthe spelen, kidney, fat body and ovary (27, 1991).

In mice, feeding and painting of 2mg extract of black pepper on 3 days a week for 3 months resulted in an increase in tumour bearing mice. Vitamin A reduced tumour incidence. Feeding a diet (50g powdered black pepper/3kg food) had no impact on carcinogenesis (32, 1990). Safrole or tannic acid (constituents of pepper) when injected into mice during the preweaning period were found to be weak carcinogens. Forced feeding of d-limonene but not piperine (constituents of pepper) reduced the carcinogenic activity ofthe safrole, tannic acid and methylcholanthrene (22, 1992).

Human Nutrition

Eight Indian spices, including pepper, did not affect the protein digestibility of sorghum nor of chickpea. The BV of sorghum diets with spices was higher for black pepper + cumin (1:1 mix) - 28, 1991). The average per capita consumption of spices in India is 9.54g and this gives 1.2 to 7.9% of the average adult Indian male's requirement for different nutrients. Black pepper, along with seven other common spices were so evaluated (15, 1993). The mineral composition (stored in the form of phytate) of the perisperm tissue of P nigrum fruits has been investigated along with the content of the perisperm of other species (1, 1995).

Nutrition - Experimental Animals

In rats, the effect of black pepper and piperine on the growth, the blood constituents and the organ weight have been investigated (70, 1981). Using rat isolated epithelial cells, piperine stimulated gamma-glutamyl transpeptidase, increased lipid peroxidation and increased the permeability of the cells to amino acids (24, 1992). Studies in rats have shown the influence of a mixture of 11 spices (black pepper included) on protein uptake from winged bean Psophocarpus tetraconolobus and horsegram Dolichos biflorus (3, 1994).

Medicinal Activity

Biochemical studies in mice fed with 2% (highest value of those tested) black pepper in their diet for 20 days suggested that pepper may have a role as an inducer of a hepatic detoxification system and might b used in further studies in chemical carcinogenesis (14, 1993). Piperine showed lower potency than Silymarin (a recognised plant sourced hepatoprotective drug) in mice with livers damaged by tert-butyl hydroperoxide and carbon tetrachloloride (13, 1993). Piperine has been shown to have low capsaicin-like properties of stimulating oxygen uptake, mediating in vasoconstriction in the perfused rat hindlimb. This is relevant to the the current interest in the future development of such thermogenic (pain control) agents. (Other capsaicin-like molecules were tested - capsaicinoids, gingerols, shogaols and resiniferatoxin) (6, 1994). The ethanolic extract of the ripe pepper fruits was active in the agar well diffusion test against a penicillin G resistant strain of Staphylococcus aureus (5, 1994).

Miscellaneous

Abstracts of the papers presented to the meeting of the American Chemical Society in India have been published (no more information has been given in the record) (51, 1986). The biosynthesis of piperine in black pepper has been described (35, 1990). White pepper was 1 of 28 spices investigated in the form of their water extracts for the feeding attraction activities on 2 species of fish, adult Oriental Weatherfish and juvenile Yellowtail (31, 1990). The reference 62, 1984, "In vitro responses of black pepper Piper Nigrum" is not commented on because of lack of data.

LONG PEPPER - Piper longum

Cultivation

P longum has been reported as a new host for Collectotrichum gloeosporioides Penz (8, 1985). Neem kernel suspension reduced by 70% the severe damage caused by Helopeltis theivora Waterhouse to tender foliage of P longum in India (5, 1991). The micropropagation of P longum has been achieved through organogenesis. The in vitro grown shoots were used as explants for callus induction leading to shoot induction. The details of the media used were given and the rooted plants were successfully established in soil (4, 1992).

Chemical Composition

The alkaloids of the fruits have been investigated (9, 1983). The isolation of the aristolactams and 4, 5-dioxoaporphines from P longum has been reported (6, 1988).

Medicinal Activity

A coronary vasodilating amide, dehydropipernonaline, has been isolated from P longum (7, 1986). In mice, the hepatoprotective potency of piperine from black and long pepper was tested for their reduction in the liver damage caused by tert-butyl hydroperoxide and carbon tetracholoride. Piperine's hepatoprotective potency was lower than that of silymarin (3, 1993). In mice, P longum in an Ayurvedic medicine (Pippali rasayana) contributed to the management of giardiasis and was considered to stimulate the immuno-modulating system of the mouse (2, 1994).

Pharmaceutical Industry

P longum fruits for the Indian pharmaceutical industry showed a high incidence of contamination with Aspergillus spp. (a source of mycotoxins such as aflatoxins) and with Fusarium oxysporum (1, 1995).

3.5 SUMMARY OF CONSUMER RESPONSE TO QUESTIONS ON PEPPER

Over 100 consumers were interviewed in the U.K. and selected European countries, i.e. Belgium, France, Germany, the Netherlands and the U.K., regarding their awareness and attitude towards pepper. In general, the points that emerged were as follows:

- There was 100% awareness of pepper as an ingredient in cooking. Every respondent was aware that pepper is an ingredient used in cooking.

- There was some confusion in the minds of the public between Capsicum, long pepper and black/white pepper. In general, consumers seemed to prefer long pepper and/or black/white pepper for cooking and tended to view Capsicum as a recent arrival or something slightly "faddish". There were reported instances of allergy to Capsicum.

- Pepper in itself was not agreeable to at least 30% of the consumers interviewed, who said they would like to limit their intake as it gave them stomach irritation and tended to "heat them up".

- The 70% who appeared to like pepper said that they found that it warmed them and sometimes cleared up a cold coming on by drinking hot drinks or eating food containing pepper.

- Less than 20% were aware of the medicinal use of pepper in herbal products and only 10% of the interviewees were aware of its specific uses in herbal medicine.

- When the medicinal uses of pepper and the use of pepper as an ingredient in

natural medicine was explained to them, they were, in general, 80% were interested in trying it when they had a specific requirement rather than in buying a pharmaceutical product.

- In general, consumers were not averse to buying products from China and Asia, commenting that as long as the product did its job, they did not care where it originated. However, 20% did comment that they would prefer to have products made in Europe, as they were not sure of the products produced in Asia.

3.6 FUTURE DEVELOPMENT POTENTIAL

3.6.1 Rural Development Potential

Spices have the potential to play an effective part in rural development. For instance, recognised world health promoters like the World Health Organisation (WHO) and some governments are considering traditional medicine, which extensively utilises spices like pepper in remedies, as an important complement to accepted medical practices. The government of Ghana, for example, has made the development of herbal medicine one of its official strategies for alleviating poverty and has appointed a Deputy Director in charge of herbal medicine.

Through its positive impact on food production, nutrition, health, rural services and the creation of inter-sectoral linkages, spices contribute to the reduction of poverty, particulary of vulnerable groups in rural areas. A large number of spice crops is characterised by low overhead costs, short duration (implying quick cash turnover) and labour intensive operations. This indicates that spices are ideal small farm crops. Spices also have high export potential and this makes them attractive to large scale investors, particularly from a processing viewpoint, which in turn offers opportunities for inter-sectoral linkages. The export component also places the sub-sector in a favoured position for receipt of incentives.

Although there are limitations in the production systems of developing countries, available data suggest that marketing spices like pepper is less of a problem than other agricultural commodities. Collection and handling procedures could still be improved but generally most countries have in place some kind of institutional arrangement for export marketing. Inadequate supply seems to be a more common problem than oversupply or lack of trade-off. In spice marketing, developing countries' vulnerability to fluctuations in world market prices is the primary problem.

There appears to be a need for a more coordinated approach to spice production. Efforts should be made to maximise production in countries which have a comparative production advantage and good market potential, and this should be translated to the farming community to take full advantage of market demand. This means that in most cases small farmers will have to be convinced to change their methods of operation to methods which they will be able to see as possessing self-sustaining benefits to themselves. Because cooperatives may be necessary for the smallholder to increase production, efforts must be made to assist the small farmer in organising producer groups. The Commonwealth Secretariat (Food Production and Rural Development Division) and other international agencies offer assistance in establishing organisations like small farmers' associations.

Nucleus/outgrower farming is another means of increasing output. Through this, the small farmer would be provided with production input and technical assistance by a nucleus farm which would benefit from more output to augment its own production. Such relationships are particularly beneficial where processing facilities are involved because of the added possibilities for creation of inter-sectoral linkages.

Promoters of spice production should lobby for greater incentives to the sub-sector commensurate with high development potential so that private investors will increase investment. Both foreign and domestic private investors should be targeted through structured planning and coordination between the public and private sectors, with due regard for the rural community.

While it is important that modern technology be harnessed in order to improve production, great care must be taken to ensure that it is compatible with local environmental, economic and social conditions. It is important to provide technology which will enable farmers to be more efficient without displacing them while keeping their rural and sociological environment balanced and strong. To this end, indigenous technology should be used as much as possible.

Small producers must be supported so that they may mobilise their own resources for development. Influential sources like governments, the private sector and the international community must effect greater integration of activities from producer to market, not only to meet export requirements, but also with the primary objective of assisting the development of the rural community.

["Spices and Rural Development", Item 7.6, Doc. ISG3:13/91, of the Provisional Agenda for the Third Session of the International Spice Group meeting at Kingston, Jamaica, 18-23 November 1991, International Trade Centre, UNCTAD/GATT and Commonwealth Secretariat.]

3.6.2 Pharmaceutical Development Potential

The prospects for further development of pepper utilisation in European pharmaceutical products at present seem to be small. It is conceivable that volumes could grow by another 10 tonnes/year during the next five years. However, certain legislative constraints in Europe are likely to mitigate against this. In Germany, one of the major markets, the Nachzulassung procedure now requires that all registered medicines have evidence of clinical efficiency.

This is very costly, even in the case of a single pharmacologically active ingredient formulation (a mono-phytotherapeutic product), and uneconomical when more than one active ingredient is involved. Hence when many of the old traditional products come up for review, the multi-ingredient formulations (see Section 5.2) are likely to disappear and be replaced by mono-ingredient products or those containing relatively few ingredients.

Given the long and well respected traditions of Ayurvedic and Chinese medicine, and the very rapid growth of the Pacific Rim countries, it is likely that most growth in utilisation of pepper in pharmaceutical products will occur in India and the Far East. In the short term, the rapidly expanding market for phytomedicines in Korea offers good prospects for growth

in the utilisation of pepper. In the longer term, the best prospects are to encourage the use of pepper in India and China, which have very substantial and rapidly growing markets.

An alternative approach would be to investigate some of the compounds which can be derived from pepper and to develop markets for any useful pharmacologically active substances found. For instance, constituents of the essential oil have antibacterial and antifungal activities and piperine can enhance the availability of other drugs to the body.

3.6.3 Developments in Uses of Pepper

Work is being done to prove the antimicrobial (antibacterial and antifungal), antiviral (including HIV), antiprotozoal and anticancer effects of pepper, but studies are at the academic stage. New medicinal uses will probably not be fully developed in the West until ten years from now. For those areas of the world where the crude extracts of medicinal and aromatic plants can gain approval for medicinal use, the time for placing products containing pepper onto the open market could be as little as five years.

Piper nigrum is being investigated as a natural antifungal agent for use in the agriculture and food industry and as an antibacterial agent against, for example, nine strains of tuberculosis. Its extract, Piperine, is noteworthy for its reputed high antibacterial and antifungal activity. [**Appendix 1:** Report by Dr. Roland Hardman, Pharmacologist.] Piper nigrum may also be useful against protoyoan parasites. Ethanolic eiptracts of P nigrum exhibit high activity against staphylococeus * strains resistent to penicillen G. [Information from Dr. Foss.]

In summary:

1 Development in the use of pepper as antimicrobial (antibacterial and antifungal), antiviral (including HIV), antiprotozoal, anticancer agents, etc., is now at the academic stage.

2 Development for medicinal uses will not be complete until at least ten years from now. However, in areas of the world where crude extracts are used for medicines (e.g., South East Asia), the time for placing such a market could be five years.

3.6.4 New Technological Developments

Value will be added to costs arising from processes carried out by producing countries through downstream processing. The following are methods currently employed:

(1) Cryomilling (Freeze Grinding)

Liquid nitrogen is injected directly into the grinding zone of the mill. This chills both the pepper and the mill and absorbs the frictional heat of milling. Pepper oil oxidation is reduced, fineness of powder is improved, essential oil losses are halved, milling rates are increased and product stability improved. In addition, there are lower microbiological counts and lower iron contents in cryonmed material compared to conventional stamp milling.

(2) Irradiation of Pepper

Gamma irradiation of pepper can eliminate microbiological and insect infestation of the product effectively. No change in the product's chemical quality is involved, nor any change in flavour, quality, color or appearance, according to Dr. R. Foss, however western consumers are increasingly wary of irradiated spices and foods.

(3) Insect Control by Carbon Dioxide

Pepper can be cleared of insect pests very effectively and cleanly by introducing high carbon dioxide levels into the storage chamber.

(4) Micro-encapsulation

Certain essential oils have been micro-encapsulated to "package" the aroma and taste to prevent degradation. A spray-drying technique has been used to micro-encapsulate cardamom oil in malto-dextrin or gum acacia capsules. The technique might be applicable to pepper.

(5) Miscellaneous

Various value-added pepper products have been produced, such as a green pepper essential oil (steam distilled) and a polyhydric alcohol based extract, which might have application for pharmaceutical raw materials.

(6) Compounds of Pepper

As indicated in Section 2.1.6 earlier in this report, no evidence for the use of piperine, chavicine, piperidine and piperettine in registered pharmaceutical or herbal products can be found.

However, Houghton et al. at the Department of Pharmacy, King's College, London, have recently found that extracts and constituents of Piper nigrum have antibacterial activity against Mycobacterium tuberculosis.

3.6.5 Strategies for Promotion

Although pepper is universally known, investigations show that there may be scope for expansion in countries where per capita consumption is low and where convenience food is popular. At present, generally only brand names are promoted, aimed at enlarging the market share of individual companies, not the actual consumption of spices.

Any project aimed at promoting pepper or, for that matter, any other commodity, would have to be tailored to achieve specific objectives. Strategy and tactics would vary according to what is desired. If, for example, a country wants to achieve a higher share in the global market for a particular commodity, a series of measures would have to be designed to project the product of that country as being superior to others. For example, oil and oleoresins of pepper might be projected as superior and more hygienic than raw pepper.

Global trade in spices has been increasing, according to the International Spice Group (ISG). From an annual average of 220,000 tonnes valued at US$300M during the period 1970-75 it grew to more than 300,000 tonnes valued at about US$750M in 1978-90, and to 370,000 tonnes valued at US$1,000M in the period 1981-85. Global trade in spices in 1988 was valued at US$1,581M.

In order to promote pepper on a global scale, a quick review of alternatives is necessary in order to identify areas which could yield the highest results at the lowest costs. The factors that would be taken into consideration would include the nature and rate of growth of a country's population; income per capita and rate of growth; consumption patterns/eating habits; rate of growth of related industries such as restaurants, flavour and fragrance industries, etc.; and cost of promotion.

Once the area to be developed has been chosen, a detailed analysis of the structure of the market must be undertaken in order to identify the precise sections of the market which must be targeted. Then target consumers must be identified and an approach determined. For example, in order to promote pepper oil and oleoresin, one may choose to target food processors. In order to promote raw pepper, grinders, packers and manufacturers of oils and oleoresin may be targetted. In some cases, strategy may be to target the housewife, particularly in countries like India where spices are processed primarily in households.

Selling propositions must be determined next, and campaigns created to attract consumer interest. Once a strategy has been formulated, its effectiveness must be reviewed periodically and the optimum time in which it is to take place limited.

Potential for faster growth is enormous. Global demand could increase dramatically in the rapidly growing food processing industry, for example, through a minor shift in consumer preferences. A well-conceived, long-term strategy involving all producers and trade operators, and also end-users where present, is necessary.

[Above information obtained from: "Strategies and Measures for Promotion of Spices", Item 10.4 (Doc: ISG3:24 /91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

4. RECOMMENDATIONS

Our recommendations are divided into three sections as follows:

1. **General Points:**
   Recommendations in General for All Pepper Growers and Individual Suppliers of Pepper and Pepper Extracts to the Market.

2. **Recommendations to Pepper Producing Countries.**

3. **Recommendations to the International Pepper Community.**

4.1 General Points: (relevant to the above three sections)

The market for Pepper and Pepper Extracts is essentially a derived demand, i.e., it is correlated to the demand for herbal, cosmetic and pharmaceutical products containing pepper and will therefore depend upon the growth of these markets.

In general there is a major upturn in the demand for herbal products and for products with herbal ingredients in Europe and America. However, this is for herbal products made largely in Europe and the U.S. indigenously, which do not contain pepper as an ingredient in any significant quantity.

Pepper as an important ingredient is found extensively, however, in Ayurvedic, Chinese and Unani products and it is the growth of the market of these products in the West that will directly benefit pepper producers.

Unfortunately, the powerful lobbies of the western pharmaceutical industries as well as the emerging herbal medicine lobby must be dealt with regard to the import of Indian and Chinese herbal products into Europe and America. They often cite poor quality, contamination and lack of scientific data as reasons for preventing the entry of these products into local markets.

One of the first battles that the three different interest groups involved in the pepper industry, i.e., the producers, the producer countries and the International Pepper Community, will have to fight is the battle for gaining recognition and product licenses for Asian and Chinese herbal products in the European and U.S. markets.

The present system for licensing is stringent and hopefully will be relaxed in the future. Western governments do not accept the clinical and toxiciological research carried out in other countries and insist upon testing products themselves before allowing them into their own markets.

The attitude that other countries' research methods are not scientifically sound stems from commercial interests and scientific establishments. It mush be countered by governments complying with other countries' regulations and attempting to meet the requirements of individual governments as far as possible. This idea must be tackled with vigour by the

governments of the countries concerned, both in bilateral terms as well as through international agencies such as the United Nations and the World Health Organization.

In other words, if western research is acceptable for western pharmaceutical products sold in developing countries, why should not the same criteria apply to research carried out in Asia and China.

4.2 Recommendations to Pepper Producing Countries:

Use of Pepper in Pharmaceutical Products

At present the pharmaceutical industry does not appear to use pepper to the extent that it might. Only about 20 tonnes per year are utilised by the pharmaceutical industry, which is only 0.07% of the total. Utilisation by Far Eastern companies is estimated to be no more than 10-15 tonnes. Total world utilisation in registered pharmaceutical and herbal products is estimated as no more than 40-50 tonnes at present.

Investigation into this matter revealed that pharmaceutical traders should:

- Continue to supply the small volumes required by traders in Germany [**Table 6:** Actual End Users and Potential Traders of Pepper for Pharmaceutical Use, on page 30 of this report.]:
- Expand utilisation of pepper in the Korean herbal and pharmaceutical industry, and supply requirements through traders or direct to end users;
- Develop utilisation of pepper in the Indian and Chinese herbal and pharmaceutical industries and supply requirements as needed;
- Investigate the pharmacological activity of pepper derivatives and develop markets for any useful compounds discovered;
- Investigate the potential for substitution of chillies in pharmaceutical products requiring pungent properties.

Experimental studies have shown that piperine and piperidine have wide and varied pharmacological actions which may in future be used in drug formulations.

For example, Piper longum has been used successfully with Butea monosperma in Ayurvedic herbal medicines to treat chronic dysentery and worm infestation. Piper nigrum may also have useful activity against protozoan parasites. Ethanolic extracts of P. nigrum exhibit high activity against Staphylococcus aureus strains resistant to penicillin G.

Methods for Promoting Desired Demand

As mentioned under the section above, pepper producing countries, particularly those like Indonesia, Malaysia and India, must actively campaign and pressurise governments to extend recognition to herbal medical products produced in China and Asia and to accept the

scientific data that has been gathered in these areas after extensive clinical research.

To put it bluntly, it is necessary to put up a fight. A high level government delegation from four or five pepper producing countries, including Indonesia, Singapore, Malaysia and India, perhaps at ministerial level, should make a joint visit to the headquarters of the European Community and to selected EC governments to convince them about the usefulness of these medicinal products in the European market and thereby get approval for importation.

A joint press campaign could be launched in conjunction with the International Pepper Community through the European media. It should be directed at consumers as well as governments, and highlight the medicinal benefits of natural medicines containing pepper, supported by scientific evidence. Questions regarding why governments are not allowing these products into these countries should be addressed publicly.

Pepper producing countries can also run seminars and workshops/conferences in their own countries, inviting pepper/pepper extract buyers from Europe to observe the quality of their herbal medicinal products and production methods and to presenting clear evidence of their efficacy and safety.

The economic and monetary interests of these buyers are such that if they are convinced that these products can be marketed in their countries profitably, they will want to distribute them.

To summarise, pepper producing countries should actively promote the sale of pepper-containing products and their safety/efficacy in Europe, and help other producer countries to contact buyers/distributors through buyer/seller meetings in their own countries as well as in foreign markets.

A number of other measures may be taken alongside the International Pepper Community, as outlined in the next section.

4.3 Recommendations to The International Pepper Community

The International Pepper Community has to act as an information and promotional agency actively promoting pepper and pepper extracts in the buyer countries in Europe and America.

Our recommendations are focused primarily on the herbal, pharmaceutical and cosmetic sectors of the European and U.S. markets. To achieve penetration of these markets, it is necessary to .naintain close contact with developments in them.

It is also important to remember that this is a very dynamic market where vast changes are taking place in a short period of time, driven primarily by consumer demand for natural products. This demand is regardless of the products' country of origin although in fact a preference exists in this market for the more established systems of traditional medicine, i.e., Chinese and Asian.

It is necessary for the IPC to counter this in an active way through increasing the demand for Chinese and Asian herbal products and by lifting the ban on them. This will naturally increase the derived demand for pepper and pepper extracts. To achieve this end, we recommend that the IPC take the following steps:

1) Co-ordinate lobby visits to European countries by ministers of producer countries.

2) Assist in organising fairs and exhibitions in Europe as well as in producer countries.

3) Establish a press monitoring service that will obtain information on major articles on pepper and herbal medicine appearing in western newspapers, herbal trade magazines, and scientific journals relating to medicine or pepper.

4) Develop a relationship with the World Ayurvedic Foundation and the Council for Complementary and Alternative Medicine in the U.K., which is the body governing all herbal medicines which is recognised by the European Community as the official mouthpiece for all traditional medicines produced here.

5) Contact editors of trade journals in order to disseminate information on pepper.

6) Coordinate visits of alternative medical journalists from Europe to Asian producers.

7) Provide information and assist pepper exporters.

8) As part of a programme to promote consumption of pepper in the United States, the IPC should launch two activities:

   a) Generic promotion of pepper in collaboration with producer countries.

   b) Publicity programme to convey the specific characteristics and quality of pepper. In order to stimulate demand for spices, both the individual efforts of national bodies in producing countries and those of spice associations in importing countries have been sporadic and limited, with the notable exception of the American Spice Trade Association (ASTA).

(Major spice processors and packers in industrialised countries, and more recently in spice producing countries, have begun undertaking promotional activities on behalf of brand names. These are largely confined to point-of-sale activities such as the use of display counters at retail outlets and distribution of brochures and recipes to consumers, supplemented with limited newspaper and television advertising, since the latter in particular is very expensive. These efforts are mainly aimed at enlarging individual companies' shares rather than increasing consumption of spices overall or of individual spices.)

Pepper, tumeric, celery along with its respective oils, and oleoresins were the main items selected for promotion. This is being implemented by Lewis & Neale Inc.

9) The IPC should participate in international trade fairs every year. For example, the Spices Board of India and Indian exporters have taken part in the following:

- International Fancy Food and Confection Show in New York
- FIE (Food Ingredients Europe) in Paris
- ANUGA World Food Market in Cologne
- Autumn Fair in Muscat.

10) Engage in a promotional strategy for pepper as follows:

- Identify thrust area, e.g., European Herbal Medical market where promotional campaign is to be undertaken;
- Study the structure and nature of the market in the selected area (MTW reports are available on the EC Market for Herbal Medicines);
- Determine the mix of promotional measures suitable for the area, e.g., newspapers, radio programmes, alternative health journals (television is too expensive);
- Draw up a strategy - a joint exercise of producing countries, trade (both producing and consuming countries), consumers (such sections as need to be involved) and selected public relations/publicity agencies; and
- Draw up a budget, assess optimum time period, and determine sources of funding. A budget of at least £50,000 to £100,000 per annum is necessary for effective promotion. This can be reduced by targetting one or two countries per year.

11) Promotional measures that should be taken:

- Advertisements (slides, films) in various news media, e.g., through radio, magazines, health journals, newspapers and editorials by friendly journalists;
- Participation in fairs and exhibitions;
- Contact through regular correspondence including mailing of information kits;
- Contact with the news media, supplying information kits where appropriate;
- Herbal medical exhibitions, festivals, cooking competitions.
- Workshops, seminars, conferences.

[Above information obtained in part from: "Strategies and Measures for Promotion of Spices", Item 10.4 (Doc: ISG3:24 /91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

These cooperative ventures indicate the need for, and demonstrate the importance of, such efforts. In the case of spices, cooperative action is feasible for pepper, vanilla, cardamom, nutmeg, mace and pimento.

Although pepper is a spice that is universally known and used, investigations suggest that there may be scope for further expansion in demand. For example, in countries where per capita consumption is at present low, and in the convenience food and institutional sectors. National promotion activities, whereby the product of a single producer country is promoted, could be complemented by a multinational campaign.

The diverse experience of commodity promotion, both national and international, over the past thirty or forty years, shows clearly that successful campaigns are generally those to which commodity producers, be they groups of farmers or groups of countries, are financially as well as psychologically committed. In the case of commodity promotion by groups of developing countries, it is increasingly clear that finance from national and international agencies is more readily forthcoming when funds are committed from the producer countries concerned.

If the desired objectives of a promotional programme are to be achieved, such activities need to be undertaken in a sustained manner and over a period of years, preferably three to five years.

[Above information obtained in part from: "Status of Promotion", Item 10.1 (Doc: ISG3:21 /91), International Trade Centre, UNCTAD/GATT, and the Commonwealth Secretariat, Provisional Agenda for the Third Session of the International Spice Group meeting in Kingston, Jamaica, 18-23 November 1991.]

3. OBJECTIVES

3.1 FIRST STAGE

1. Current Use of Pepper and Pepper Extracts

Introduction

Black pepper consists of the dried unripe fruit of *Piper nigrum* L. (family Piperaceae) a perennial climbing plant cultivated in the Malay Archipelago, southern India. Madagascar, South America and the West Indies. Large quantities are obtained from Indonesia, Sarawak and Brazil. The fruit is globular, about 3-6mm in diameter, with a wrinkled, reticulated dark brown or greyish-black surface. White pepper is prepared from riper fruit with the outer pericarp removed: it has therefore a slightly smaller diameter and the vascular bundles are visible as longitudinal lines on the yellowish-white surface. Taste and odour, pungent, characteristic.

Pepper and Pepper extracts [of very unripe (green) and unripe (black) and more ripe (white) fruits] are major components of the flavour industry. The constituents are as follows:- (i) Volatile oil, about 2-4% in black pepper but less in white pepper, containing *beta*-bisaboline, camphene, *beta*-caryophyllene, *alpha*-cubebene, *beta*-farnesene, hydrocarveol, limonene, myrcene, myristicin, *alpha*-and *beta*-pinene, sabinene, safrole, *alpha*- and *beta*-selinene, *alpha*-thujene, etc, [see Aromatherapy Chart 357 below] (ii) Alkaloids, in black and white pepper, the major pungent principle being piperine, up to 11%, with piperanine, piperettine, piperolein A and B, piperidine and traces of others (iii) Miscellaneous: fixed oil, protein, etc.

Pepper is used throughout the world as a condiment. Recent market data is available from Singapore. Pepper being its most important spice export. In 1993 Pepper accounted for 33,092 metric tonnes (32% of its total spice business) which was exported mainly to Netherlands and Germany. For quality, there is the Singapore Standard 315:1986 - Specifications for Black Pepper and White Pepper (Whole and Ground). This Standard is being updated with "steam heat based natural sterilisation", which method McCormick Ingredients South East Asia Pte Ltd. Singapore and Hiang Kie Pte Ltd. Singapore, use for pepper. Tan SEOK LEE "Singapore Spice Trade", 4emes Rencontres Internationales - Nyons, 5,6,7 decembre 1994, pp 76 - 79, see photocopy enclosed.

* **Is pepper or are pepper extracts currently used in the pharmaceutical and herbal medical industries?**

  Yes, to a very small extent.

* **Identify what pepper and pepper extracts are used in the pharmaceutical and herbal medicine industries?**

  Essentil oil and oleoresin.

* **Identify what quantities of pepper and pepper extracts are used by each relevant medicine type in the pharmaceutical and herbal medicine industries?**

  Negligible amounts of essential oil and oleoresin.

* **Rank uses of pepper/pepper extracts in terms of their importance based on quantities required.**

  Negligible compared to the current and rising demands of the flavour industry.

* **Establish the opinions of researchers and pharmacologists on:**

  Anticonvulsive, vasodilatory, antihelminthic and antiinflammatory activities have not been reported in the the pharmacology index of the Review of Aromatic and Medicinal Plants 1995, Volume I. Nos 1, 2, 3 and 4. (CAB International, Wallingford, Ed. D. J. Cousins, ISSN 1356-1421.)
  The activities, anticonvulsive, vasodilatory, antihelminthic and antiinflammatory, tend to be those traditional to medicine of South East Asia including those of Ayurvedic medicine - Chopra, in the Glossary of Indian Medicinal Plants (R N Chopra, S L Nayar, I C Chopra, Council of Scientific & Industrial Research, New Delhi, 1956),

  "Fruit - used as aromatic stimulant in cholera, in weakness following fevers, vertigo, coma: as stomachic in dyspepsia and flatulence: as antiperiodic in malarial fever: as an alterative in paraplegia and arthritic diseases: externally used as rubefacient and as a local application for relaxed sore-throat, piles and skin diseases."

In the Aromatherapy Chart no 357 the "Traditional and Esoteric uses/actions tabulated are:- analgesic, antiemetic, antimicrobial, antiseptic (urinary), antispasmodic, antitoxic, aperitif, aphrodisiac, bactericidal, carminative, diaphoretic, diuretic (?), expectorant, febrifuge, laxative, odontalgic, rubefacient, stimulant-(nervous, circulatory, digestive), tonic- (nervous system, glandular, cardio-vascular). Character: Yang" The Aromatherapy Practitioner Reference Manual by Sylla Sheppard-Hanger, published by the Atlantic Institute of Aromatherapy, Florida USA, 1995. ISBN 0-9643141-O-X in 2 volumes. Volume II, M-Z and indices.

In the West the fruits of *Piper cubeba* have been preferred to those of *P. nigrum*.

The medicinal uses of the fruits of *P. cubeba* are described as aromatic, diuretic, expectorant, carminative and used for bronchitis, coughs and urinary tract infections. The ground fruits have been found to be effective in treating amoebic dysentery. The oil is reputedly antiviral in rats and antibacterial *in vitro*. The British Pharmaceutical Codex 1949 included doses for Cubeb Oleoresin, Oil and Tincture. Potter's (Herbal Supplies) Limited of Wigan probably still supply their Asthma and Chest Mixture based on Cubeb.

Piplartine, (Piperlongumine), a pyridine alkaloid, found in the roots of *Piper longum and P. sylvaticum* is reported to be effective for the treatment of asthma and chronic bronchitis. Phytochemical Dictionary edited by Jeffrey B. Harborne and Herbert Baxter, published by Taylor & Francis, London, 1993. ISBN 0-85066-736-4.

- **the anticonvulsive and vasodilatorial properties of piperine and some piperine derivatives.**

  Lesley Bremness, in her book "World of Herbs" published by Ebury Press, London 1990, ISBN 0-85223-821-5, states in the Aromatherapy section "**Pepper Black** *(Piper nigrum)* Safe. This is a warming oil which brings the blood to the surface, stimulating circulation. It is used to treat coughs, colds, high temperatures and muscular aches and pains. It is also employed to treat disorders of the digestive tract."

  Aromatherapy is now being used in selected cases of epilepsy. Whether oil of pepper is included in such trials

is not known. Caution against kidney damage is stressed when oil of pepper is used via the skin in aromatherapy oils. Aromatherapy Charts for the oils of *P. nigrum* and *P. cubeba* are enclosed (Nos 357 and 355 respectively) from the above "The Aromatherapy Practitioner Reference Manual".

The Charts indicate a toxicity and contraindications naming some of the relevant compounds. **alpha-Phellandrene** occurs in oil of pepper as the (+) form (also in oil of fennel and as the (-) form in other oils eg, eucalyptus oil). Harborne and Baxter (see above) say this compound "Can be irritating to, and absorbed through, the skin. Ingestion can cause vomiting and/or diarrhoea. It is used in perfumery."

D A Moyler et al (Proc 12th ICEOFF Vienna 1992 pp52-100) [page 78 enclosed] "All carbon dioxide extracted black pepper oils have to be carefully fractionated to remove all of the piperine homologues and resinoid components for application to skin contact fragrances without skin reddening. As early as 1967 carbon dioxide extraction of pepper was reported [108] and verified [109]. A GLC fingerprint analysis of pepper oil has been published [46]."

- **piperine and piperine derivatives in synthesis with other natural plant extracts in use as an antihelminthic and antiflammatory including consideration of:-**

the reliability in the pharmaceutical and herbal medical industries;

In the West, their reliability is disputed. Elsewhere, eg, in South East Asia, their reliability is accepted as traditional medicine.

the actual applicability of the reported behaviour.

Applicable to areas of the world where they form part of traditional medicine.

2 Potential Uses/R & D for Pepper and Pepper Extracts

* **Identify if other uses for pepper/pepper extracts are currently being researched, developed or considered?**

Yes. New medicinal uses may well result from the **combination** of academic research and developments in extracting pepper initiated by the flavour industry for its own interests.

If they are:

- **What are the possible uses being developed?**

  As antimicrobial agents (antibacterial and antifungal); antiviral agents (including HIV), antiprotozoal agents; anticancer agents, etc.

- **What stage of development are they at?**

  All the above agents are at an academic stage.

- **How long will it be before these new uses are fully developed?**

  For new medicinal uses, at least 10 years.

  However, in those areas of the world eg, South East Asia, where the use of crude extracts of medicinal and aromatic plants can gain approval for medicinal use, the time for placing such a product on the open market could be 5 years.

* **Identify properties of pepper and pepper extracts.**

Four isolates from the Tincture of Pepper (currently available commercially, principally for the "drinks" industry) showed equal activity against 9 strains of *Mycobacterium tuberculosis*. **Piperine** was identified in the isolates by co-chromatography and is regarded as the active compound. P J Houghton, A Astaniou, J M Grange and M Yates. J Pharm. & Pharmacol. 1994 46 Supplement 2 1042. Dr M D Yates is in the Public Health Laboratory Service, Regional TB Centre, Dulwich Hospital, East Dulwich Grove, London SE22, UK. Tel: 0181 693 2830. I telephoned him and he has developed an excellent method for the rapid screening of many plant extracts for activity against

M. tuberculosis and this has been published: Telles M A S. Yates M D (1994) Tubercle and Lung Disease 75 286-290.
(A photocopy is enclosed.)

This development from pepper and pepper extracts could be very important commercially. At present an expensive cocktail of synthetic compounds is used to try and control the spread of TB in the USA and other parts of the world with growing populations of peoples with limited means of supporting themselves, as well as those with the AID Syndrome. The labour costs involved in ensuring compliance of the dosage regime with the cocktail is an additional high cost.

* **Identify other possible uses, in the pharmaceutical industry, for pepper and/or pepper extracts.**

Both aqueous and ethanolic extracts (tinctures) of fruits of *Piper nigrum* fruits have exhibited high activity against a Penicillin resistant strain of *Staphylococcus aureus* growth in an agar well diffusion test method. PEREZ, C; ANESINI, C. **Antibacterial activity of alimentary plants against *Staphylococcus aureus* growth.** *American Journal of Chinese Medicine* (1994) 22 (2) 169-174 [En, 9 ref]. This is another example of the antibacterial activity which can be derived from pepper. It is at an academic stage and would take up to10 years for development to an "approved" stage.

There is a current demand for naturally occurring **antifungal agents** for use in agriculture and the food industry and *P. nigrum* is being investigated for this purpose. Some examples are:-

Benzene extracts of *P. nigrum* have shown activity against the mycelial growth of sclerotia-forming fungal pathogens of *Sclerotium rolfsii [Corticium rolfsii], Rhizoctonia solani* and *Sclerotinia sclerotiorum.* CHAUDHURI T; SEN, C. Zeitschrift fur Planzenkrankheiten und Pflanzenschutz (1982) 89 (10) 582-585 [En, de 7 ref].

Of 31 extracts, maximum inhibition of *Drechslera oryzae* in rice was shown by extracts of peppermint leaves, followed by *P. nigrum* "seed" and garlic extract. ALICE, D; RAO, A V. International Rice Research Newsletter (1987) 12 (2) 28 [En].

P. nigrum essential oil was included in antifungal studies by JAIN. S R: JAIN M R. in Planta Medica (1972) 22 (2) 136-139 [En. 7 ref].

Of crude aqueous extracts of 127 plant species *P. nigrum* extract was the most inhibitory to *Rhizoctonia*-like isolate # 8. GARCIA. R P: LAWA. M V P. Philippine Agriculturist (1990) 73 (3-4) 343-348 [En, 9 ref].

P. nigrum essential oil showed good antifungal activity in general against [*Curvularia] lunata [Cochliobolus lunatus], Rhizopus* spp., *Aspergillus* spp. and *Penicillium* spp. CHAURASIA. S C: KHER. A. Indian J Hosp Pharm (1978) 15 (5) 139-141 [En. 11 ref].

Furthermore. antiprotozoal properties have been shown in extracts of the fruits of *P. nigrum*. (See AGARWAL, page 8)

Pepper oil is not recommended for the control of gram-negative bacterium - *Aeromonas hydrophila* in cooked meat (essential oils of Coriander or Clove are recommended). STECCHINI. M L: SARAIS. I: GIAVEDONI. P. **Effect of essential oils on *Aeromonas hydrophila* in a culture medium and in cooked pork.** *Journal of Food Protection* (1993) 56 (5) 406-409 [En. 21 ref]

However. other extractives of the fruits of *P. nigrum* might well prove to have the desired activity for preserving cooked meat. in view of the foregoing antibacterial activity reports.

Piperine and its isomers: Four different geometrical isomers exist. namely the *E.E.* form (**Piperine**), the *Z.Z.* form (**Chavicine**) the *E.Z.* form (**Isochavicine**) and the *Z. E.* form (**Isopiperine**). The activity of "**Piperine**" could well be improved by the selection of the most active isomers from the mixture for a particular purpose. The mixture is readily available by the use of carbon dioxide as the solvent in the extraction of pepper fruits and methods of isolating the individual isomers are also available. For example. Universal Flavours plc. have the "know how".

Sigma Chemical. Fancy Road. Poole. Dorset BH17 7BR. Telephone: 0800 447788. Fax: 01202 715460. offer in their 1995 catalogue. "piperine" at £50.50 for 25g. The other isomers are not listed. Piperidine is priced at £39.70 for 1 litre and they also supply many piperidine salts. The most expensive is "Piperidine-

4-sulfonic acid" (a specific GABA agonist) at £176.20 for 250mg. "GABA: *gamma*-Aminobutyric acid: Piperidic acid is an inhibitory transmitter at the neuromuscular junction in the central nervous system. It has been used to treat cerebral disorders, including coma, and is hypertensive." - Phytochemical Dictionary (see above).

Other species of *Piper* are revealing new activities which may also be available from *P. nigrum*. R E SCHULTES has studied the plants of the Amazon, notably for their value in the treatment of the elderly (an area receiving much attention by the pharmaceutical industry) and for those "who sit staring into space all day", he recommends an infusion of *P. schultasii*. Ciba Foundation Symposium 185 "Ethnobotany and The Search for New Drugs", published by John Wiley & Sons Ltd. Chichester, 1994. ISBN 0 471 95024 6. page 169.

Another example is that of antiprotozoal properties of *Piper longum* (Pippali) with *Butea monosperma* (Palash) in an Ayurvedic medicine, Pippali rasayana, for the management of giardiasis by an immuno-modulatory activity. AGARWAL, A K et al. Journal of Ethnopharmacology (1994) 44 (3) 143-146 [En, 8 ref].

3. Extraction of Pepper Components

* **Identify methods of extraction and isolation/separation of components of pepper for use in pharmaceuticals and herbal medicines and the machinery required.**

The equipment available for the extraction of pepper for use in the flavour industry and the associated facilities of its research and development departments should be adequate for the purpose.

* **Identify recent advances and trends in the extraction and isolation/separation processes with a view to future developments in this technology.**

The simple percolation process for producing tinctures (ie extraction with aqueous ethanol) is now carried out also by "pump percolation". (A "tincture" is often the product preferred by the "drinks" section of the flavour market.)

Oleoresin extraction by eg. acetone is commonly practised but in removing acetone towards the end of the process, terpenes come over and can be added to oil of pepper but also kept as a terpene fraction and further fractionated for a variety of uses. (The oleoresin is adjusted to contain eg. piperine 40% and oil 20% for the flavour industry.)

Steam distillation is still the main process for the production of the volatile/essential oil of pepper. Some companies, in the West, have abandoned this process preferring to purchase cheap oil from their subsidiaries in the country of origin of pepper, eg, H E Daniel of Tunbridge Wells from their company in India.

Carbon dioxide as a solvent for extraction of pepper is now used under a wide range of conditions to produce "carbon dioxide black pepper oil" with advantages over steam distilled oil in that no extra terpenes are generated during the process.

A variety of other extracts, some of which can have a very high concentration of crystalline piperine, are also available by carbon dioxide extraction under a range of conditions. Mr David Moyler of H E Daniel Ltd has kindly supplied some of his published information which is enclosed (pp 77, 78, 79 & 98). This includes a comparison of pepper oil obtained using carbon dioxide as solvent and by steam distillation, giving the compositions of these oils revealed by GLC. *Proc. 12th ICEOFF, Vienna 1992* pp52-100 "Ten Years of Carbon Dioxide Oils" by D A Moyler, R M Browning, M A Stephens. ISBN 3-95001-82-1-2.

Sabinene which is reported in the above GLC data is said to occur in Sri Lankan pepper oil and to be absent from Indian pepper oil. MCCARRON, M; MILLS, A; WHITTAKER, D; KURIAN T; VERGHESE, J. **Comparison between green and black pepper oils from *Piper nigrum* L. berries of Indian and Sri Lankan origin.** *Flavour and Fragrance Journal* (1995) **10** (1) 47-50 [En. 22 ref]

3.2 SECOND STAGE

Market Research

1 Market Size and Growth Trends

* **Identify the current pharmaceutical and herbal medical market sizes for pepper and different pepper extracts.**

Negligible.

* **Identify growth trends for pepper and pepper extracts in the pharmaceutical and herbal medical industries.**

No significant growth.

* **Estimate the quantity of pepper and its particular components that may be demanded in the pharmaceutical and herbal medical industries in 5 and 10 years from now.**

5 years: negligible
10 years: slight increase, but still insignificant compared with the growing volume of pepper needed for an expanding flavour industry. This expansion is stressed in Tan SEOK LEE's paper above which states "For example, China presently has a per capita consumption of only 10 grammes of pepper per annum compared to 119 grammes and 117 grammes respectively for Hong Kong and Brunei. If the per capita consumption in China increases by a mere 1 gramme, it would mean that China had to import or increase by 1,200 metric tonnes per year. This scenario is also applicable to countries such as the Philippines and Indonesia which presently have a low per capita consumption of 15 grammes and 26 grammes respectively."

Furthermore, she states "Singapore companies will also be encouraged to add more value to their spice trade. For example, we hear of opportunities to manufacture value-added pepper products such as pepper perfume, medicinal pepper rub, pepper oleo-resin, pepper air-freshener with germicidal function etc."

2 Market and Consumer Analysis

- **Identify who the main pepper suppliers are to the pharmaceutical and herbal medical industries.**

These are also the suppliers to the dominant flavour industry. Some UK examples of international companies are:-

Universal Flavours PLC. Bilton Road. Bletchley, Milton Keynes. MK1 1HP Tel: 01908 270270. Fax: 270271

H E Daniel Ltd. Longfield Road. Tunbridge Wells, Kent TN2 3EY Tel: 01892 511444. Fax: 510013 (Indian black pepper oil by steam distillation £39.50 per kg. Indian oleoresin £24 per kg - prices from stock in UK.)

Lionel Hitchen Ltd. Gravel Lane. Barton Stacey, Nr Winchester. Hants. SO21 3RQ Tel: 01962 760815. Fax: 760072 (Black pepper oil produced on site by steam distillation £60 per kg and Oleoresin £20 per kg.)

British Pepper and Spice Co Ltd. Rhosili Road. Brack Mills. Northampton. NN4 7AN Tel: 01604 766461. Fax: 763156

McCormick Ingredients South East Pte Ltd. Singapore with its USA branch at
McCormick. Baltimore. MD. USA and supplying the world-wide chain of Macdonalds' fast food outlets.

2 **Synthetic Competition**

Negligible at this stage.

* **Compare pepper and pepper extracts with other chemicals that are competitors to pepper for use in the pharmaceutical industry including consideration of:-**

- **price**
- **quality**
- **availability**
- **efficacy**

Not applicable because at this stage the competitors are not yet identified.

Prices, etc. for antiinflammatory (synthetic steroidal and non-steroidal), anticonvulsive, etc pharmaceuticals can be found. However, this would best be done when the pepper sourced alternative is known and "approved" for a defined medicinal use.

* **Identify how the relative strengths of pepper and its competitors will change with future technological advances.**

The flavour industry will continue its high demand for pepper. Pharmaceutical uses are simply a spin-off and the demand for medicinal purposes is unlikely ever to affect the volume required by the flavour industry.

3. **Extraction/Isolation Processes**

* **Identify the cost of extracting/isolating the various useful components of pepper as identified in stage one, using the various processes and technologies currently available.**

There will be a negligible additional cost to the flavour industry which will absorb the cost of any product for pharmaceutical use while exploiting this use or by-product in some aspect of the flavour and related industries eg. perfumes, cosmetics, aerosols.

* **Rank the processes and technologies for extraction and isolation/separation by:-**

(most important = 1)

- **cost** 5
- **quality** 2
- **reliability** 1
- **efficiency** 3
- **speed** 6
- **quantity** 4

"Ten Years of Carbon Dioxide Oils" by D. A. Moyler, R.M. Browning, M.A. Stephens, Proc 12th ICEOFF, Vienna, 1992, pp. 52-100

From "Ten Years of Carbon Dioxide Oils", by D.A. Moyler, R.M. Browning, M.A. Stephens, Proc 12th ICEOFF, Vienna, 1992, pp. 52-100.

Figure 20 - Cardamom Oils, Comparative GLC

Applications to Formulae

Flavours:

Flavour applications of cardamom spice and its extracts are numerous. It is an essential ingredient in genuine East Indian curry powder, that is apart from its use as a spice in blends and in the canning industry for pickles, meat sauces, seasonings etc.

In Scandinavia, cardamom is added to bread and baked goods and in the Middle Eastern countries it is added to coffee and grilled meats.

The MPFT is 0.05mg% (0.5ppm) for CO_2 extracted cardamom oil.

Fragrances:

Fragrance applications of the CO_2 extract include the bright fresh spicy lift it gives to many spice and citrus fragrances. It is a classic ingredient for blending with coriander, bergamot, lemon and petitgrain for superb fresh colognes. The lack of harsh degradation products enables higher levels to be used in increased initial impact on the skin. This is proven in a published demonstration formulation of a classic cologne, where it is used at 3% to impart long lasting freshness [*102*].

PEPPER OIL - piper nigum ex Malaysia (India, Brazil)

Description: A clear pale blue-green mobile oil with fragrant spicy odour.

Physical Constants @ 20°C;	L.CO_2	Steam Distilled
Specific Gravity:	0.870 to 0.900	0.890 to 0.900
Refractive Index:	1.480 to 1.490	1.480 to 1.500
Optical Rotation:	-1° to -11°C	-1° to -23°C
Solubility in 90% v/v ethanol:	1 in 7 opal	1 in 7 opal

The oil of black pepper is produced from the crushed dried, slightly under ripe fruits of the perennial climbing vine. Its main production area is South India, but there is significant commercial production in Sri Lanka, Indonesia, Malaysia and Brazil [*103,104*].

Yield of oil is 1.5 to 2.0% by steam distillation and CO_2 extraction but has been reported to vary as widely as 1.0 to 2.6% [*69*].

From "Ten Years of Carbon Dioxide Oils", by D.A. Moyler, R.M. Browning, M.A. Stephens, Proc 12th ICEOFF, Vienna, 1992, pp. 52-100.

Figure 21 - Comparative Odour Profile [*33*]

Major components of $L.CO_2$ extracted black pepper oil [*33*] are:-

Sesquiterpene hydrocarbons 55.5%:	δ elemene 3%, α cubebene 0.3%, α copaene 3%, β elemene 1%, β caryophyllene 38%, α humulene 2%, δ cadinene 1%, others 7.2%.
Monoterpene hydrocarbons 44%:	α thujene 0.2%, α pinene 4%, camphene 0.1%, β pinene 8%, δ 3 carene 17%, L-limonene 14%, γ terpinene 0.2%, para cymene 0.4%, terpinolene 0.1%.
Oxygenated components 0.5%:	Terpinene 4-ol 0.1%, α terpineol 0.1%, caryophyllene oxide 0.3%.

The growing, harvesting and analysis of pepper was published by Lawrence as part of his major tropical series [*105*] and he subsequently reviewed other publications [*106,107*].

A GLC fingerprint analysis of pepper oil has been publsihed [*46*]. All CO_2 extracted black pepper oils have to be carefully fractionated to remove all of the piperine homologues and resinoid components for application to skin contact fragrances without skin reddening. As early as 1967 CO_2 extraction of pepper was reported [*108*] and verified [*109*].

Vitzthum et al patented [*110*] a process of dry $S.CO_2$ extraction with subsequent wet CO_2 extraction of the extract to 7% of yellow solid. They also reported [*111*] on aroma extraction with $L.CO_2$ at 25° to 60°C and 65 to 400 bar after $S.CO_2$ extraction of oleoresin.

The quantitative extraction of piperine and oil at 60°C and 300 bar for 3 hours was reported [*12*]. A two stage extraction of pepper at 100 bar and 60°C using hexane entrainer at 20g/kg of CO_2 [*25*], from which, after separation at 53 bar and 25°, 1.4% of pepper oil was obtained. The residue was extracted at 300 bar and 60°C with ethanol entrainer at 26g/kg CO_2. A viscous yellow mass of 6.5% yield was obtained which assayed at 90% piperine by UV determination at 343nm.

Sankar [*112*] described the extraction of pepper oil with CO_2 and postulated a method for evaluating the quality of extracted oil.

Figure 22 - Pepper Oils, Comparative GLC

Applications to Formulae

Flavours:

The full, dry, rich spicy odour of CO_2 black pepper oil can be appreciated in a whole range of piquant sauces, soups, meats, pickles and chutneys. Other carbon dioxide extracts containing piperine give extra aroma in addition of pungency in snacks, instant noodle products and meat patés. The 'freshly milled' pepper notes of CO_2 extracted pepper enhance the perceived quality of foods in which it us used. The MPFT is 0.2mg% (2ppm) for CO_2 extracted pepper oil.

From "Ten Years of Carbon Dioxide Oils", by D.A. Moyler, R.M. Browning, M.A. Stephens, Proc 12th ICEOFF, Vienna, 1992, pp. 52-100.

Fragrances:

The characteristic 'freshly milled' pepper aroma of a specially chosen, fragrant variety of peppercorns gives unsurpassed character to spice accords. These notes are especially important to men's fragrances. It is also an important modifier in carnation and other distinctive floral bouquets and has been demonstrated in a formulation at 3% [*102*]. This oil has better solubility and more impact than steam distilled oil because no extra terpenes are generated during processing.

NUTMEG - Myristica fragrans ex West Indies (India, Sri Lanka, East Indies).

Description: A clear yellow oil with sweet spicy odour.

Physical Constants @ 20°C;	$L.CO_2$	Steam Distilled
Specific Gravity:	0.906 to 0.956	0.860 to 0.922
Refractive Index:	1.470 to 1.500	1.472 to 1.488
Optical Rotation:	+10 to 35°	+10 to 45°
Solubility in 90% v/v ethanol:	1 in 9 opal	1 in 3 opal

The seed kernel of the deciduous tropical nutmeg tree is dried before use. The oil derived is often assessed for flavour use by its content of myristicin and elemicin, but some doubts have been expressed about its safrole content of up to 3% from some sources. For fragrance use a low safrole content is most desirable and the oil from West Indian spice has about 0.2% safrole, although the myristicin level is a little lower than some Indian and East Indian oils. Prolonged steam distillation of nutmegs (because the high lipid content acts as a fixative for the oil) causes thermal degradation reactions, including hydrolysis of trimyristin, and the formation of higher levels of p-cymene, terpineol isomers and sabinene hydrate than found in CO_2 extracts.

Figure 23 - Comparative Odour Profile [*34*]

Major components of $L.CO_2$ extracted nutmeg oil [*34*] are:-

Monoterpene hydrocarbons 36%: α thujene 1%, α pinene 5%, sabinene 20.7%, β pinene 5%, β myrcene 1%, para cymene 0.5%, limonene 2.5%, γ terpinene 0.5%.

Sesquiterpene hydrocarbons 2%: α cubebene 0.2%, α copaene 0.6%, β caryophyllene 0.6%, δ cadinene 0.2%, others 0.4%.

Myristicin and Elemicin 5.5%: Ratio 1:2.

Other oxygenated components 8.5%: Linalol 1.5%, terpinen 4-ol 2.6%, α terpineol 0.5%, safrole 0.2%, linalyl acetate 0.5%, p menth-2en-1-ol's 0.5% terpinyl acetate 0.2%, geranyl acetate 0.3%, bornyl acetate 0.1%, methyl eugenol 0.6%,

From "Ten Years of Carbon Dioxide Oils", by D.A. Moyler, R.M. Browning, M.A. Stephens, Proc 12th ICEOFF, Vienna, 1992, pp. 52-100.

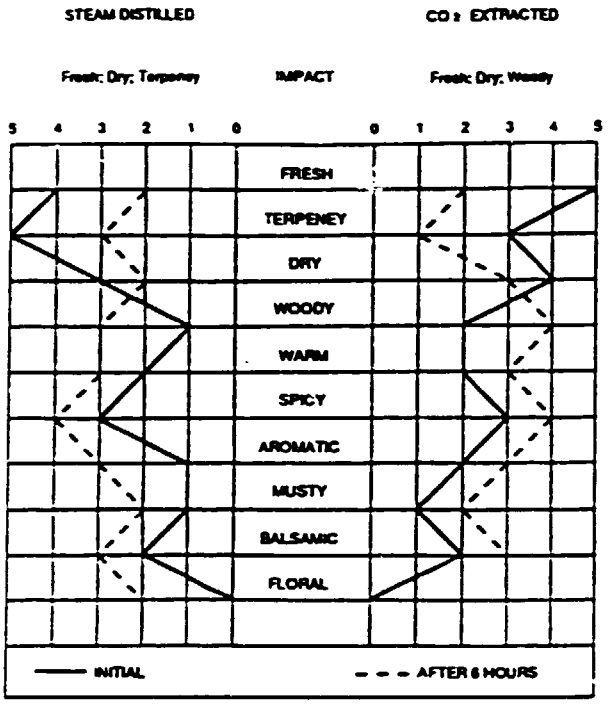


Figure 21

Comparative Odour Profile

PEPPER

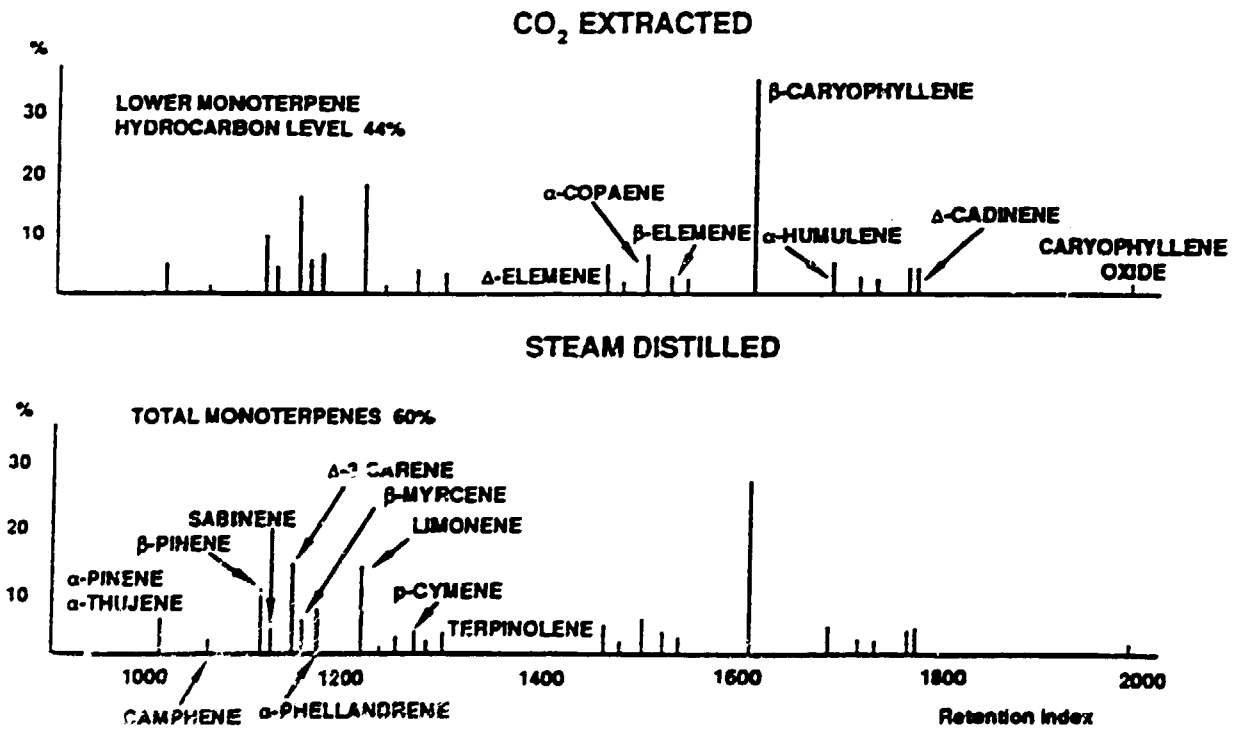


Figure 22

Pepper Oils

Comparative GLC

SPICES IN AYURVEDA

P.K. Warrier
Managing Trustee, Arya Vaidya Sala, Kottakkal - 676 503.

The term "Ayurveda" means knowledge or Science of life. Although people take it as the Indian System of Medicine, it is to be understood in its broader dimensions, not simply as studies of methods and medicines to treat diseases, but as studies and instructions on the ways of life. All Ayurvedic classical texts start with chapters with captions as "Deerghamjeevateeya" (Charaka), "Ayushkameeya" (Ashtanga Hridaya) meaning for the benefit of those who are to have a long life. But courting of long life is not to be let to your private choice. All have to aspire for it. Everyone is born with a mission in life. To fulfill that mission a man has to live his full span of life — 120 years. It is everyone's duty to do his best to prolong his life by strictly abiding to the instructions for the upkeep of health, physical, mental or spiritual. Negligence towards this duty is the greatest sin. It is called Prajnaparadha. It is the prime cause of all diseases. So Ayurveda is to teach how to live, how to behave, knowing oneself and the world around with its changes, how to plan life, utilising everything beneficial to life, all substances, actions and opportunities and avoiding all that are harmful. So all Ayurvedic texts start with Swastha Vritta — regimen for healthy man. And find all causes of diseases in the violation of the rules of healthy living.

The origin of Ayurveda, according to mythology is from Brahma. It means that care for the protection and prolongation of life and cure of diseases were the concern of man from his origin itself. The Vedas and Tantras bear testimony to that spirit. In those days civilized men's mind also were dominated by magic. Along with hymns, worships and rituals, we also find many selected substances used at rituals to propitiate Devas who blessed them with health and prosperity and to drive away evil spirits, which attacked as diseases. Ghee is used for oblations, the fumes of which are naturally health promoting. Mustard is used to drive away evil spirits. A synonym for mustard is Rakshoghna. It really works in protecting from microbes. Turmeric (*Curcuma longa Linn*) has its place in rituals. Adharvaveda has it mentioned as Naktamjata, meaning born at night. It is good antiseptic and blood purifier besides carminatives. All these properties were taken as their magic power, "Mahatmya" or later "Prabhava". If we trace development of these advances; we can see how many substances that we have today in daily life got approval from the experience of our ancient forefathers. Often it was from the experience of generations, they got conviction that the above mentioned substances are acceptable since they do not harm but only help to promote our health. Hymns and articles were gradually grouped as per properties. Those that help to cure diseases were termed Bhaishjyani. Those that helped to promote life span — Ayushyani.

But the term "Ayurveda" became in vogue only with the Samhitas, Charaka, Susruta, Kasyapa Samhita, Bhela Samhita, Hareeta Samhita and other classical texts. These were composed at about 600 B.C. By now a thorough change in outlook and approach had advanced. Magic receded. Real rationalistic, objective studies, regarding the constitution of the nature, animals, man, anatomy, physiology and study of the property of substances, how they work in body, the material causes of diseases, their diagnosis, methods of treatments like purificatory and alleviative, rejuvenating, virilising etc., were fully advanced on a scientific basis. This is Ayurveda. It had the traditional wealth of experiences and philosophies of Samkhya, Yoga, Naya and Vaisesika as epistemological background, studies of articles and methods of treatment from neighbouring civilized countries

and a new renaissance here itself that worked on this background and revealed Thridosha Theory. The Thridosha Theory provided a functional, holistic, and field-oriented approach, seeing health in the equilibrium of doshas, Vata, Pitta and Kapha and diseases due to their upsetting. So the properties of substances, actions and changes were studied, related to their influences on these doshas. properties are studied how they help to promote the system of life.

Ayurveda as described above is for promotion of life and prevention and cure of diseases. All those depend on three fundamental factors. Ahara (diet), Nidra (sleep), and Abramacharya (sex). If these three factors are properly attended and not abused life is prolonged.

In diet care not only section of the articles of food, but also the way in which they are consumed, are important. Very detailed instructions for selecting wholesome food stuffs and for avoiding unwholesome ones, overeating, untimely eating, food stuffs that are harmful to health by their combinations and others are given. Dietetics in Ayurveda is a very important subject. It has attracted scholars from abroad (like Dr. Ballantine of Pensylvania) who have their own studies, giving enlightenment and valuable informations to the western doctors also.

Diet and medicine are not to be totally separated i.e. put in water tight compartments in Ayurveda. They overlap each other. Food stuffs and medicines are studied both analytically and synthetically. But synthetic properties are preferred valuable than analytical findings. They are studied in the language of tastes. There are six tastes. Sweet, sour, salty, bitter, pungent and astringent. Of these, sweet sour and salty act against Vata, increase Kapha; Bitter, pungent and astringent act against Kapha, increase Vata. Astringent, bitter and sweet act against Pitta. The other tastes increase Pitta. So by studying the taste of each article we can presume how they act, but there are other properties also. They are Veerya (potency), Vipaka and Prabhava. All tastes have their Veerya, which is either hot or cold. Heat reduces the body cold increase. Vipaka is the post-digestive taste. Sweet and salty tastes in Vipaka acts as sweet. Sour as sour. Bitter, pungent; and astringent as pungent. So by observing a taste we can presume how they act pro or against the doshas, and their Veerya and Vipaka. But sometimes we find exceptions to these rules. An article of food with pungent taste ought to provoke Vata. But ginger does not provoke Vata, heals Vata. Ginger and Long pepper also pungent in taste are sweet in Vipaka as an objection to this general rule. Garlic though pungent in taste and post-digestive stage is not provocative of Vata but an effective medicine to heal it. So by taste, post-digestive taste or by Potency also we cannot ascertain the final action of a dravya or substance. There is a Prabhava or a special action that over-rides others. As the article has some basic properties that cannot be assessed by analysis, more importance be given for the holistic property of an article.

It is with such a view, Ayurvedic preceptors select article of food and medicine. For selecting dietetic articles, taste has got first preference for medicines Veerya or potency., A dietetic article can be used as a medicine and medicines as food. A balanced food is one in which all tastes are represented, their proportion to be determined as per the type of man, his present need, climate etc. But anyhow all tastes are to be included in the preferred order.

According to Ayurveda, diseases are to be expelled by improving vital energy or ojas — balam. Basically this is achieved by promoting the biological rhythm: For this purity of the system is the first necessity. So in selecting medicines and articles of diet first preference is for Dhatusamya — affinity to the system, Suddhi (Purity) and the resulting balam, ojas. It is with this outlook diebetic articles are also selected. Now amongst the 26 spices approved by the Spices Board, 25 excluding Vanilla, are those approved by Ayurveda, both useful as dietetic articles and also as medicine.

Let us start from the tuber which has a synonym "Oushadha (medicine) and Mahoushadha (the great medicine)."

Ginger *(Zingiber officinalis)*

Ginger, long pepper, and pepper are together called Thrikatu or three acrids. These three acrids as a group are ingredient of many formulations intended for digestive troubles. Thrikatu is medicine for cough, obesity, elephantiasis, slackening of digestive capacity, asthma, and cold (chronic and new) says Ashtanga Hridaya.

Ginger although acrid in taste, in post-digestive (Vipaka) acts as sweet and cures Vata and works as a tonic. It removes obstruction in body pores. It promotes virility, and is a good appetiser. In Veerya (Potency) it is hot but unctous and light and increase digestion. There are many many recipes with ginger fresh and dry.

There is a saying that "no kashayam without dry ginger." Dry ginger powder in hot water, hot salt water with jaggery, decotion or as electuary with other medicines are used. In distension of stomach it is given with castor oil. It is very effective in Amavata with pain on the joints. It is also taken with Soda-bicarb. Stomach pain and nauses due to purgatives are relieved if taken with powder of dry ginger. In cold fevers, patients are given decoctions of dry ginger and then covered well and let to perspir. Dry ginger powder six grams, ghee six grams, jaggery 30 grams are joined together (melting the ghee and mixing ginger and jaggery) and kept as a bolus and taken in morning or evening relieves cold, headache and cough. Ginger one dose, jaggery double the quantity and two times of it fried sesamum is a combination popularly known as Gulasundhi for cough. Ginger is good to stop diarrhoea and at the same time to remove constipation. Diabetic patients when eating sweet fruits like ripe mango if taken with dried ginger powder can be free from troubles. After delivery to relieve Vata troubles, dry ginger decoction is served. One tola of ginger powder, in half a seer of milk and half a seer of water boiled and reduced to milk taken 21 days, gives wonderful effect in Leucorrhoea. One tola of ginger powder mixed with sugar taken repeatedly in small quantities relieves stomach pain. In headaches with Pitta in excess, dry ginger and sandalwood are pasted together and applied on the forehead. All Vata dominating headaches are cured by applying a paste made of dry ginger powder, cinnamom bark, roots of castor plant and cloves on the forehead. In fatigued conditon of cholera, when hands and feet are cool and muscles are with tension, rubbing with dry ginger powder gives warmth and blood circulation is regained. The toe of the feet is covered with ginger paste in these conditions. Garlic piece also can be mixed with ginger powder. In unconscious states, collyriums are applied with ginger pastes or powders. In hysteria and insanity, ginger is used as collyriums and errhines mixed in water or salt water. For all pains application of ginger paste helps. In liver suppurations, externally ginger and ammonia or ginger and deodar in water or cow's and goat's urine are applied. Because of the mainfold usages, it is called Viswabheshaja — medicine for the world. Fresh ginger (Ardraka) is diuretic and cold in Veerya and it can be used as dry ginger. But dry ginger is hot in potency while fresh ginger is cold. It is the juice of Ardraka used more as medicine. For anorexia and indigestion juice of fresh ginger, lemon juice and rocksalt are taken together before meals. Two tolas of Ardraka juice seven tolas of cow's milk mixed together boiled and reduced to half and mixed with sugarcandy, if taken at bed time relieves delirium due to Pitta. Fresh ginger juice and sugarcandy taken twice a day is good for diabetic patients. Dr. Koman in the Indigenous Drugs report, Madras states that fresh ginger juice when properly administered will be found beneficial in cases of cirrhosis of the liver with ascitis and dropsy of the lower limbs.

Ashtanga Hridaya says "Ardraka with equal quantity of jaggery taken in each day increasing 2 1/2 tolas upto 25 tolas by month with a diet of vegetable soup and milk oure disaeses as Gulam (misperistalsis), Udara (ascitis), dropsy, diabetes, asthma, chronic cold, immobility of organs due to obstructed intestinal movements, jaundice, consumption and mental troubles, cough and all diseases due to Kapha.

There are many simuar recipes. Sowbhagya Sundi is such a popular recipe t.ke. by women after delivery and by all who want to improve their complexion and health.

The other two members of the three acrids are pepper and long pepper.

Pepper *(Piper nigrum)*

Pepper is pungent in taste and post-digestion taste or Vipaka. It is light and destroys Kapha.

Nighantu Ratnakara says "Pepper is acrid and bitter, light, hot and appetiser. It stimulated digestive fire. It is sharp. It diminishes semen and is abrasive and emaciative. It is dry increases Pitta decreases Kapha and Vata and destroys worms. Asthma, cough, heart troubles and pains are relieved by it. It heals diabetes and piles.

White pepper is neither too hot or cold. It is best of all peppers and good for the eye; says Susruta in Sutra sthana. 5 to 10 grams of pepper powder with honey, ghee or sugar or jaggery, or 1/4 or 1/2 tola of this in any decoction with honey and ghee or with lime juice or sour liquids can be taken in Pepper heals fever. It is good particularly in irregular fever. A decoction of pepper and *Ocimum sanctum* itself could relieve influenza and was very popular in a previous epidemic. In places where filaria is endemic, daily use of pepper is a protective. In curing elephantiasis, it was used with good result. In various skin diseases with itching, external application of pepper with milk is prescribed. In gonorrhoea it is given with milk and sugarcandy. Its fumes are made to inhale by epileptic patients during their falls. It is antipoisonous. For Nyctalopia pepper with curds is applied in the eyes as collyriums. These are only some of the varigated uses of pepper so common amongst our people.

Long pepper *(Piper longum)*

For all troubles in which liver and spleen are affected, Long pepper is the best medicine. It is a rejuvenating medicine also. 5 to 8 or 10 long peppers as per the genotype of the man, if taken daily for a year, gives full rasayanic effect. Long pepper kept in the solution of Kshara (alkali) of Indian coral tree (Erythrenia variegate) in water at night, dried at day time fried in ghee, if taken daily, three per day, with honey before both meals is also rasayana. If the above process is repeated many times, the benefit also will be more. This is not only rasayana but medicine for cough, consumption, breathing troubles, traumas hiccup, troubles of the throat, piles, dyspepsia, anaemia, irregular fevers, voice troubles, cold, misperistalsis and all diseases due to Vata and Kapha.

Vardhamana Pippali — Ten Long pepper ground and pasted with milk on the first day. Then increase by ten each day. When the number is 100, then start reducing by ten on each day. So by nineteen days 1,000 Long peppers are taken in. Each day after the medicine is digested diet of Shashtika rice with milk and ghee is given. This is not only a rasayana. It is very effective to cure ascitis due to liver of spleen. It is good to increase semen and prolong life and to improve intelligence.

The ordinary dose of long pepper is 5-15 grains with ghee, honey and sugar. 10-60 grains with decoctions and milk or with equal a quantity of rocksalt and ghee. It is milder than ginger and pepper. With ginger it destroys Vata and with pepper it destroys Kapha. Long pepper is used in many ways against lung diseases, against Beriberi, for asthma and bowel troubles, use of long pepper with goat's milk is popular in Kerala.

Dried long pepper is poisons internally or externally if cooked in oil or ghee used for frying fish.

Haridra *(Curcuma longa Linn.)* — Turmeric)

We have already observed how it was popular even in Vedic times. It is used variously as condiment. curry powder and a dyeing agent and particularly as a medicine. It is Naktamjata — born at night — and so all synonyms of night as Nisa. Thriyama. Rajani are used for it. Being yellow in colour. in Tamil and Malayalam it is know as "Manjal." It is a symbol and token of auspiciousness. It is a Prasadam of temples. particularly of mother goddess. Application of it on the face is good to remove unwanted hairs. besides imparing loveliness and complexion. As an ingredient curry powder it improves the flavour and helps on a good antiseptic and anti-poison factor. It is recognised as aromatic. stimulant. tonic carminative and anthelmintic.

According to Ayurveda and Siddha — in Rasa it is Katu (pungent) and Thikta (bitter) and in Veerya (potency) it is hot. It is Ruksha (acute) and is used to cure wounds. diabetes. anaemia. blood impurities. worms and chronic cold.

It enters in a number of formulties. For diabetes. the first prescription is to take in every morning. the juice of Embelic myrobalan (amalaka) and turmeric with honey. It is in kashayam and powders to cure diarrhoea and amoebiasis. It is anthelmintic. after delivery ladies smear turmeric over the body and take buttermilk boiled with turmeric to protect them from infection.

Kashayams. powders. lehyas. oils. intended for external and internal uses in skin diseases. all contain turmeric. Turmeric powder taken with cow's urine. or applied externally is the best medicine for Pruritis.

Neesosiradi oil is the oil preparation with turmeric vettiver and Bala and medicines and Eladi group specially for diabetic patients to protect them from boils and abscesses.

Turmeric with *Ocimum sanctum* is a common remedy to be applied in bites of insects including scorpion. Cuts and wounds are healed by application of turmeric powder. After leaching the wound is sprinkled with turmeric powder. In smallpox and chickenpox paste of turmeric and Neem leaves is applied in to facilitate the process of scabbing. In country sore eye and conjuctivitis. turmeric and tamarind leaves boiled in water is used as a lotion to relieve pain and swelling. The fumes of the burning turmeric produces a copious discharge and gives instant relief to catarrah and coryza. Turmeric is found to reduce eosinophelia. Rajanyadi choornam. Saraswatha choornam and many other recipes intended for the promotion of health and intelligence of children contain turmeric. A very popular recipe with turmeric is Haridrakhandum which is the best medicine for curing Pruritis and Urticaria and all skin diseases.

Garlic *(Allium sativum)*

The importance of garlic as a medicine is stressed by our preceptors by giving it the status of Ambrosia — Amrita — but with a bad odour. It is said that when rahu and Ketu the asuras ate amrita stolen from the devas. it was spied and brought to the attention of Vishnue. who cut their neck with his wheel and the droppings of Amrita from their mouth became garlic. Many recipes of garlic are presented. There are special chapters on garlic in Kasyapa Samhita and Navaneethaka titled "Lasuna Kalpa." It is highly acute. hot in taste and post-digestion taste both acrid. is apertive. increases digestive fire and appetite. It is heavy and unctous. Good for the heart. and increases semen. It promotes growth of hair. It provokes Rakta Pitta. and heals Kapha. Vata. Gulma. Piles. cold. worms. diabetes. difficulty to breathing. skin diseases. Leucoderma. cough and hiccough.

All Vata diseases. except those in which blood and Pitta are combined are cured by garlic. Garlic with sesamum oil is given in a resayanic way. It is good to cure epilepsy and convulsive Vata diseases. It is specially good to contract the uterus after delivery. So

women after delivery take preparations with garlic. Now it is recognised as very effective for blood pressure and heart diseases. In Hysteria, distension of the stomach, and sciatica and in all diseases where Vata is pressing upwards, decoction of garlic with milk is served. It is diuretic also. Garlic removed its out skin and put in honey for 41 days and taken daily in the morning one teaspoon as a dose for one year heals Leucoderma and hoarseness of voice. It is good for consumption.

Pomegranate *(Punica granatum)*

The use of Pomegranate to heal diarrhoea, dysentry, dyspepsia and digestive disorders is well known to people all over the world. There are many mythological stories in the east and west related to the greatness of Pomegranate as a divine fruit. It is one of the symbols, carried by goddesses of the west, who bless married couple to beget children. It is said that Ganapathy also holds it as a symbol. Anyhow it is the fruit that guarantees conception to sterile woman. Dadimadi ghritam, a ghee prepared with Pomegranate, coriander, Plumbago rosea, ginger and long pepper is reputed for correcting the bowels, curing anaemia and guarantees conception for women. Dadimashtaka is a powder carminative and for curing diarrhoea and dyspepsia. Buttermilk boiled with rind of Pomegranate, turmeric, cumin and ajowan are used in our homes for treating diarrhoea, dyspepsia and other bowel troubles.

Cardamom *(Elettaria cardamomum)*

Cardamom, cinnamom, Tejpatra and Iron wood tree (Mesua ferrea) are taken together is known as Chaturjata. They are used to flavour electuaries and to promote their actions.

It is used in yogas to cure skin diseases, poisons, colds and inflammation. One Eladigana as the name signifies — starts with Ela as its first ingredient is for curing Vata and Kapha diseases, poisons and to improve complexion, to cure itchings, furuncles and others.

It is also an ingredient of yogas for improving digestion, curing vomitting, cough etc. It is used to stimulate diuresis, particularly in cases of snake-bite poison etc. A group of medicine known as 'Ariyaru kashayam' (six grains) for skin diseases of children contain cardamom.

Chilly (*Capsicum annum* Linn)

This is not mentioned in classical texts. It is said it is imported from Brazil. But now it is in popular use. Dravyaguna vijnan a recent work by P.V. Sharma has included it and its medicinal properties are described. Being acrid and hot, it relieves troubles with Kapha and Vata. It is also good to induce sleep. It increases watering of the mouth. It stimulates heart, is diuretic increases virility, cures fever, particularly irregular fever but debilitates tissues as it is acrid in post-digestion.

Coriander, Cummin, Fennel *(Foeniculum vulgare)*, fenugreek *(Trigonella foenumgracem)* ajowan, Carumcarvi are all generally included in Jeerakas. Coriander is diuretic. Its paste is applied to heal allergy due to Semicarpus anacardium. Babies stopped breast feeding showing carving for food are fed with coriander coffee. In conjuctivitis crushed corainder tied up in a piece of cloth kept in milk or rosewater is dropped in the eyes repeatedly. Cummin seed is used to correct the course of Vata, digestion and to relieve pain. During conception and after delivery cumin decoction or preparations with cumin are popular. Jeerakadhyarishtam is a popular preparation. Panchhajeeraka gudam is a reputed preparation. It is good to improve health and beauty and for women for the proper growth of breasts. It cures menstrual troubles and it is said to correct hormones.

Methi *(Trigonella foenugraecum)*

Particularly useful to cure disturbances after delivery. Corrects Vata. Externally applied for burns, wounds and swellings. It is used in cough and difficult in breathings. In smallpox it is given as a cold drink. It has anti-bacterial property, and is used to cure diabetes. It is an ingredient of Panchajeerakagudam.

Ajowan *(Trachyspermum ammi)*

It is said to be very rich in Calcium and iron. In Ayurvedic preparations it is used for correction of Vata and digestion. It is antheimintic, digestive and antiseptic. Its oil is used for cholera, pain of stomach, dyspepsia, diarrhoea, indigestion etc.

Dill (*Anthum graveolens* **Linn**).

It is very important medicine used externally and internally. Sathahwa or anise paste in Dhanyamla (Veppukadi) is very effective to heal Vata and Raktavata swellings. Navaneethaka and other classical texts have special chapters for anise named Sathahwa Kalpa. It reduces temperature in fever. It is very effective in menstrual troubles of women. It is used in Syphillis, skin diseases and piles.

Kalasaka (*Murraya koenigii* **Linn**).

This is used in liver diseases. It increases digestive power and is particularly good to expel "garam" or poisons stuffs stuck fast in the alimentary system. When curries are cooked leaves of Kalasaka are put in it to protect from poisons. It is antiseptic and heals swellings, fever, skin diseases, intestinal worms, dysentry, diarrhoea and purifies wounds.

Vrikshamla (Garcinia gummi-gutta Linn).

This is a medicine and is used as an alternative for tamarind. Pulileham is a preparation used by women after delivery and all for correcting digestive disorders. Panchamla taila used to cure swellings and dropsy contain the medicine.

Mint (*Mentha arvensis* **Linn**).

Mint is used as a carminative in preparations like Puthinahara and as a chutney.

Saffron *(Crocus sativus)*

Saffron is a very costly spice. Its usage was popular from ancient times. Carrying women used to take it in milk as they believe that it improves the complexion and beauty of the child. It is used in puddings and sweets. It is pungent, bitter and unctous. It regulates all doshas. It stops vomitting expels worms, heal headache and wounds. It is good for haemorroids. For removing the discolouration of the face and pimples Kumkumadi taila is applied. It is the ingredient of the Eladi group. Saffron and camphor are used as an additive in many oils. It is also good in epilepsy and Kapha troubles of the children.

Cloves *(Caryophyllum aromaticum)*

It is used as a flavouring spice in curries and in all digestive troubles. The griping pain of purgatives is removed if taken with cloves. It is good to stop vomitting, indigestion, headache, toothache and pain due to Vata.

The above are some of the spices used in Ayurvedic preparations. All these have some special properties very similar to the property of "Prabhava" described in the texts.

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SINGAPORE'S SPICE TRADE

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INTRODUCTION

Before I begin, I would like to thank the CERDEPPAM for giving me the opportunity to participate in this conference. I will be talking about Singapore's traditional role as a spice trading centre in the world; how Singapore is responding to the need for high standards of quality and hygiene in spice consuming countries, particularly the developed countries; and prospects for the Singapore spice trade. I will then summarise the responses of Singapore traders and the Singapore Government on how to better service the world spice market.

SINGAPORE AS A SPICE TRADING CENTRE

3Since Singapore is not a "natural producer" but a major re-export centre of spices, I shall confine my area of coverage strictly to the import, export and marketing aspects of spices handled by Singapore. Singapore's involvement in the international trade in spices dates back to more than 100 years. As it is situated in the centre of major spice producing countries of Malaysia, Indonesia, India, China, Thailand, Vietnam, Sri Lanka, Singapore has been functioning as a link for these countries to market their spices. Also, many countries have been using Singapore as a base to source their requirement of spices. Singapore trades in all kinds and varieties of spices, with pepper being the single most important item. In terms of volume and value, pepper accounted for 28% and 32% respectively of Singapore's total spice trade of 196,000 metric tonnes valued at S$378 million in 1993.

The International Trade Centre (ITC) in Geneva estimated that Singapore handles between 20 to 25 percent of world's movement of pepper trade. This substantial volume is largely due to the excellent shipping, banking and telecommunication facilities in which Singapore had heavily invested and which are constantly being upgraded to meet the changing needs of the international trade.

Among other things, Singapore provides reliable support services to its neighbours in the Asia-Pacific region as well as countries as far as countries in Africa to effectively market their spices overseas. Shipping spices through Singapore has many advantages. Availability of vessels and ready connections to almost all, including remote destinations, enables prompt delivery of spices to buyers. This is an important element in the spice trade as delay in shipment would lead to longer storage hence quality deterioration to spices especially items such as garlics, ginger, onion etc which are perishable items. For cases of delayed shipment, Singapore has also developed quality storage and warehousing facilities to maintain the quality of spices until they are shipped to their final destinations.

Now I would like to give you the following analysis of import and export of pepper, which is the single most important item for Singapore both in terms of volume and value. In 1993, Singapore imported approximately 28,000 metric tonnes of pepper valued at S$36 million. A greater portion of this volume comprised black pepper. Singapore's main sources of pepper are:

Sources	Volume
Vietnam	13,500
Malaysia	9,790
Thailand	1,000

As for exports, pepper from Singapore is exported to all corners of the world. The following were the major destinations of pepper in 1993:

Destination	Volume
Netherlands	5.239 m/t
Germany	3,583 m/t
United States	2.011 m/t
United Kingdom	1.534 m/t
Korea	1.603 m/t
France	1.351 m/t
Japan	1.081 m/t

I also wish to draw your attention that a significant volume of pepper of Indonesian, Malaysian and other origins are being transhipped via Singapore. However, due to different measurement units applied for the purpose of capturing transhipment statistics I regret that I am unable to give the breakdown for this sector of trade.

After pepper, the following were the most important spice items exported from Singapore in 1993 (in order of volume) :

Pepper	33.092 metric tonnes (32%) mainly Netherlands & Germany
Chillies	17.113 metric tonnes (17%) mainly exported to Malaysia
Cloves	14.293 metric tonnes (14%) mainly exported to Bangladesh & Pakistan
Cinnamons	7.982 metric tonnes (8%) mainly exported to India
Ginger	6.515 metric tonnes (6%) mainly exported to Pakistan
Cumin seeds	4.439 metric tonnes (4%) mainly exported to Bangladesh & Malaysia
Nutmeg	3.580 metric tonnes (3%) mainly to Netherlands & USA
Others	13.276 metric tonnes (13%) mainly to South Africa & Middle East

END-USAGE OF SPICES

With a population of plus or minus 3 million only, Singapore's domestic consumption of spices is very negligible. This would mean that almost all the spices imported into Singapore are finally re-exported with or without certain degree of value adding process. Value adding process done in Singapore, especially for pepper, would normally include cleaning, grading, sterilisation, grinding and packaging before it is re-exported. Nevertheless, I should estimate that about 600 to 800 metric tonnes of pepper are consumed in Singapore.

STANDARD AND QUALITY REQUIREMENT

In Singapore, we have a quality standard for pepper, given that it is the most important spice traded in the country. It is called the SINGAPORE STANDARD 315:1986 (SS 315) -Specifications for Black Pepper and White Pepper (Whole and Ground). The Standard spells out requirements relating to the physical characteristics of whole black and white pepper such as the minimum or maximum limits for extraneous matter, light berries, total ash, volatile oil content, non-volatile ether extract, acid-insoluble ash, crude fibre content etc. It also prescribes sampling and preparation of test samples, and methods of test to determine the above physical aspects of pepper.

In response to the growing demand from the consumers and end-users on the quality of spices, there is now a need by the spice producing and exporting countries alike to enforce stricter quality control standards. The process of quality control in spices begins in the cultivation stage, post harvest stage, and is followed through in the marketing stage. In particular, we would need to pay attention to the trends and expectations concerning the quality requirements of spices (pepper) exported to the European Community (EU). In the past few years, the European media had reported several food scandals causing many consumers to feel insecure in consuming food products. Pesticide residues in baby food or salmonella in eggs and chicken meat resulted in increased scepticism in industrial food products. The spice industry in particular has come under scrutiny in the last few years. Reports on millions of bacteria in pepper, salmonella in paprika and aflatoxin in nutmeg and chillies have caused many consumers to become cautious in using spices. Large food groups such as Burns Philp, Feruzzi, McCormick, CPC, BSN etc along with consumers, food control/governmental authorities, spice industry, food processing industry etc have all now demanded only high quality and hygienic spices from the producing countries. We hear that in Germany and the rest of Europe, legislation is being drawn up to address these issues. The European Spice Association (ESA) is also working out criteria on quality of spices entering Europe.

In Singapore, companies having been observing hygiene requirements in handling, cleaning, grading, storage and packaging of spices. In keeping with changing needs, especially, in the developed countries in Europe and the US, Singapore will now put more resources in the following two areas:

a) Review of the Singapore Standard on pepper
b) Improve quality of spices through sterilisation.

The Singapore Institute of Standards and Industrial Research (SISIR) is in the process of reviewing its SS 315:1986. The Singapore Trade Development Board (STDB), which sits in the technical committee reviewing the SS 315, is exploring the possibility of incorporating the appropriate quality standards for the sterilisation of pepper in the SS 315. It will take into account the stringent quality requirements imposed by major importers and end-users of pepper. Among other things, it will consider tolerance limits of microbiological aspects such as salmonella, E-Coli, coliform, total bacteria count, yeasts and moulds count etc. As a follow up, we will also explore the possibilities of establishing values on the permissible levels of heavy metals such as arsenic, lead, tin, cadmium, mercury, zinc etc in pepper. The SS 315 is intended to give maximum degree of assurance to buyers for their continual sourcing of pepper from Singapore.

New technologies in spice processing are now developed and utilised by the spice industry in Singapore. Some of these include the natural sterilisation of pepper by steam heat process to reduce bacterial contamination without using fumigant gases or irradiation. McCormick Ingredients South East Asia Pte Ltd, a subsidiary of the world's largest spice processing group of McCormick, has already added one and half years ago this steam-heat based natural sterilisation facility to its Singapore plant to improve the quality of pepper exported from Singapore.

PROSPECTS FOR SINGAPORE'S SPICE TRADE

Singapore has been traditionally the buyer and re-exporter of spices produced by Malaysia, India, China, Madagascar etc and one of the leading transhipment centres for the Indonesian pepper. However, Singapore is likely to handle more volume of spices from Vietnam, Thailand and India in the immediate future with the opening up of these economies in recent years. Brazil is also a potential source of supply in the long term. While the traditional markets of Western Europe and the US are expected to maintain their level of demand and the market of Eastern Europe is recovering, the demand in countries of the Asia Pacific region shows clear signs of increase.

Percapita Spice Consumption

US/W. Europe	150 g
Asia-Pacific	24 g
China	10 g
Philippines	15 g
Indonesia	26 g

Singapore being strategically located in the region, is ready to meet this demand. In general, the Asia Pacific region consumes about 74,500 metric tonnes and this gives an average per capita consumption of just over 24 grammes for all countries in this region. Developed countries such as the US and Western European countries report consumption in excess of 150 grammes per capita. With total population in excess of 3 billion, GDP growth as high as 14% per annum in some countries and averaging above 6%, the Asia Pacific region holds good prospects for increased consumption and market expansion for pepper. Among consuming countries, the markets with potential for expansion are Japan, Korea, Taiwan, Philippines, China etc.

For example, China presently has a per capita consumption of only 10 grammes of pepper per annum compared to 119 grammes and 117 grammes respectively for Hong Kong and Brunei. If the per capita consumption in China increases by a mere 1 gramme, it would mean that China had to import or increase production by 1,200 metric tonnes per year. This scenario is also applicable to countries such as the Philippines and Indonesia which presently have a low per capita consumption of 15 grammes and 26 grammes respectively.

Pepper prices had been on the decline for longer than the usual "trade cycle" for many years. It is interesting to note that pepper prices have started to move up significantly in the last couple of months. This trend, I am sure is long awaited by all in the spice trade. This will also give a boost in the trading activities of other spices.

SINGAPORE'S RESPONSES TO BETTER SERVICE WORLD SPICE MARKET

To complement the stringent requirements, new technologies on spice cleaning need to be pursued. A Singapore local company, Hiang Kie is in the process of setting up a steam sterilisation plant in Singapore. The process utilises the most advanced equipment. When completed in the early 1995, Hiang Kie's plant will be capable of sterilising other types of spices besides pepper. (Please see Annex) Singapore companies which do not have similar facility, will be encouraged to make use of Hiang Kie's facility.

Singapore companies will also be encouraged to add more value to their spice trade. For example, we hear of opportunities to manufacture value-added pepper products such as pepper perfume, medicinal pepper rub, pepper oleo-resin, pepper air-freshener with germicidal function etc. The other possibilities are in the manufacturing of spice mixes and condiments. Singapore welcomes foreign companies to set up manufacturing plants in Singapore in these areas, either on their own or jointly with Singapore companies. We also welcome foreign consultants who can provide expertise and advice on the development of new spice mixes to meet consumers' requirement.

In conclusion, the following are the areas that Singapore spice exporters need to pay attention to :

a. Consumers in developed countries are, and will become more quality conscious and concerned with health hazards associated with spice and its products.

b. Singapore exporters will need to continuously upgrade their processing facilities to meet these demands. Towards this end, the Singapore government is committed to assist its exporters through the programme to review the Singapore spice standards and encouraging investments in suitable spice sterilisation methods.

c. Singapore companies will be encouraged to invest in more value-added processing of spices. Foreign investments and expertise will be welcome.

ANNEX

HIANGKIE SPICE PLANT

Hiang Kie Pte Ltd has been a coffee and spice trader in Singapore since 1936. Apart from the trading activities, Hiang Kie has coffee-roasting facilities. It is now setting up a complete high capacity spice processing plant in addition to its existing decaffeinating plant in its Senoko premises in Singapore.

The spice plant which is now under construction will be operational by April 1995. It is capable of cleaning, steam-sterilisation and fine-grinding of all kinds of spices.

Cleaning: In order to remove foreign matters in the raw material, the product passes through a series of Swiss made equipments.

Sterilising: The latest and very advanced steam-sterilizing equipment is being deployed for this purpose. In an enclosed vessel, superheated steam is applied on the clean raw material for a short period of time. This is to ensure minimum losses of flavour, colour and aroma. Our system can handle a wide range of spices, both powder and granular. It is also capable of immediate cooling and drying which reduce the risk of re-contamination. Another feature is the ability to pack the finished product in various bag sizes to meet customers requirements.

Grinding: Our contra plex wide chamber mill, coupled with cryogenic feed can grind any kind of spices with minimum losses in aroma, essential oil and colour.

Hiang Kie is able and prepared to offer cleaned and/or processed and/or sterilized products. It also prepared to do customer's own raw material on tolling basis at reasonable and competitive prices.

ANTIBACTERIAL ACTIVITY OF EXTRACTS AND CONSTITUENTS OF *PIPER NIGRUM* AND *GALIPEA OFFICINALIS*

P.J.Houghton, A. Astatiou, J.M. Grange and M. Yates[*].
Pharmacognosy Research Laboratories, Department of Pharmacy, King's College London, Manresa Road, London SW3 6LX. Microbiology Department, National Heart and Lung Institute, Dovehouse St., London SW3 6LY. [*] Public Health Laboratory Service Regional TB Centre, Dulwich Hospital, East Dulwich Grove, London SE22 UK

Tinctures of *Piper nigrum* L. and *Galipea officinalis* Hancock showed activity against several types of bacteria including *Mycobacterium tuberculosis* (Davey et al 1990; Grange & Davey 1990). Identification of the antimicrobial constituents of these plants has not been undertaken and this was the aim of this work.

TLC separation of the tinctures (silica gel/toluene:ethyl acetate 7:3) followed by overlay with molten agar seeded with *Bacillus subtilis* showed several zones of inhibition. The same technique using *Escherichia coli* showed much weaker zones of inhibition. Visualization using Dragendorff's reagent and cinnamaldehyde (0.5%w/v in sulphuric acid:acetic acid:methanol 5:10:85) of TLC plates developed in the same system showed that the antimicrobial zones corresponded to compounds which were probably alkaloids and terpenes.

Preparative TLC using the same system to isolate the zones giving antimicrobial activity resulted in four extracts BP1-BP4 from *P. nigrum* and five GO1-GO5 from *G. officinalis*. After elution from the silica the nine isolates each gave a single spot in three different TLC systems. BP4 corresponded to piperine (1) when co-chromatographed in the TLC systems used but no other components could be identified although all the *Galipea* zones were alkaloidal and 2-alkylquinolines e.g. galipine (2) have been isolated previously from *G. officinalis*.

The broth microdilution method, using microtitre plates, was used to determine the minimum inhibitory concentration (MIC) of the compounds in Middlebrook 7H9 medium against nine strains of *M. tuberculosis*, identified by the regional TB centre Dulwich (Telles & Yates, 1994). Results are shown in Table 1.

Antimicrobial activity of *P. nigrum* or piperine has not previously been reported. Similarly the alkaloids of *G. officinalis* provide a new type of antimicrobial structure which could form the basis of further investigations into structural analogues which might have enhanced activity.

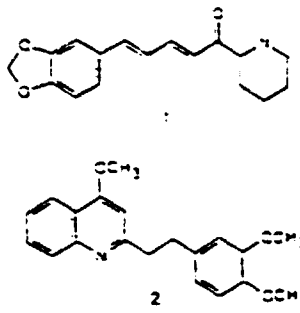

Table 1. MIC ($\mu g\ mL^{-1}$) of compounds from *P. nigrum* and *G. officinalis* against *M. tuberculosis*.

Isolate	MIC*	Isolate	MIC*
BP1	25	GO1	25
BP2	25	GO2	12.5
BP3	25	GO3	50
BP4	25	GO4	> 100
		GO5	100

* Mean of values for nine isolates.

Davey, R.W. et al (1990) Complementary Medical Research 4:1-7
Grange, J.M., Davey, R.W. (1990) J. Appl. Bacteriol. 68:587-591
Telles, M.A.S., Yates, M.D. (1994) Tubercle and Lung Disease 75 in press.

INIST Databank Item on Cardiovascular Effects Le 24/08/95

***
Titre(s) : Cardiovascular effects of piperine in anaesthetized dogs

Auteurs : HATTHAKIT (U.)/SHIDA PANG (K. K.)/PIYACHATURAWAT (P.)

Adresse bibliogr.: JN Asia pac. j. pharm./TS Asia pacific journal of pharmacology/SN 0217- 9687/OR SGP/DA 1994/VO 9/NO 2/PA 79-82/BI 12 ref.

Langue : ENG Cote & Local INIST.: 002B02A04 S1 INIST/C1 22169/L1 354000040324970030 L

Descripteurs : Pipérine/Origine végétale/Piperaceae/Plante médicinale/ Pharmacognosie/ Activité biologique/Voie intraveineuse/Chien/Animal/ Hémodynamique/ Respiration/Dicotyledones/Angiospermae/Spermatophyta/ Fissipedia/ Carnivora/Mammalia/Vertebrata

RESUME :

***
Titre(s) : An ayurvedic formulation Trikatu and its constituents

Auteurs : JOHRI (R. K.)/ZUTSHI (U.)

Adresse bibliogr.: JN J. ethnopharmacol./TS Journal of ethnopharmacology/SN 0378-8741/OR IRL/ DA 1992/VO 37/NO 2/PA 85-91/BI 1 p.

Langue : ENG Cote & Local INIST.: 002B02A04 S1 INIST/C1 18028/L1 354000031788610010 L

Descripteurs : Médecine traditionnelle/Plante médicinale/Origine végétale/ Inde/Piper nigrum/Zingiber officinale/Alcaloide/Biodisponibilité/Activité biologique/Interaction médicamenteuse/Article synthèse/Pharmacognosie/ Piperine/Piper longum/Asie/Piperaceae/Dicotyledones/Angiospermae/ Spermatophyta/Zingiberaceae/Monocotyledones

RESUME : 'Trikatu' is an Ayurvedic praparation containing black pepper, long pepper and ginger, which is prescribed routinely for a variety of diseases as part of a multidrug prescription. These herbs along with piperine (alkaloid of peppers) have been shown to possess diverse biological activities in mammalian systems. A review is presented of these studies and it has been suggested that their use in the Indian system of medicine could be due to their bioavailability enhancing action other medicaments

SURVEYING OF SANSKRIT MEDICAL TEXTS FOR CARDIOLOGICAL INFORMATION

KUMAR D.S., PRABHAKAR Y.S.

Department of Physiology, International Institute of Ayurveda,
Ramanathapuram, COIMBATORE-641045 (India)

INTRODUCTION

The indian medical system of Ayurveda is established on a set of unique concepts. Basing on the six schools of Indian philosophy, Ayurveda maintains that the states of health and diseases are influenced by three humours *vata*, *pitta* and *kapha*, collectively known as *tridosha*. As a part of our studies on the evaluation of ayurvedic medical litterature (1,2,3) we undertook an extensive search of seven Sanskrit medical texts for cardiological information.

MATERIALS AND METHODS

Susruta Samhita, *Caraka Samhita*, *Ashtangahridayn*, *Ashtangasamgrahn*, *Cakradattam*, *Sarngadhara Samhita* and *Bhaishaiyaratnavali* were examined in their entirety for information on all aspects of heart diseases. After analysis and categorisation of the drug formulae, frequency distribution of each constituent was determined. Chronology of the texts and method of identification of ingredients are described elsewhere (3).

RESULTS

All the seven authors unanimously state that heart diseases (*hrdroga*) is of five varieties viz., *vata*-dominant, *pitta*-dominant, *kapha*-dominant, occuring due to combinations of the *tridosha* and microbial (*krimija*). Detailed information on aetiology, symptoms and treatment of each of these types are also available in these texts.

The survey revealed 13 single drug remedies and 133 multicomponent formulations which are able to be administered as decoctions, spirituous liquors, powders, tablets, porridges, oils, clarified butters, electuaries, pastes and calcined powders. The 146 formulations involve 203 plants distributed in 69 families, 6 substances of animal origin, 5 inorganic compounds, 7 metals and 8 salts.
Frequency - distribution of 229 constituents showed that *Zingiber officinale* Rosc. (68.42%) and *Piper longum* L. (68.42%) are the two drugs having maximum incidence in recipes. They are followed by *Piper nigrum* L. (45.86%), *Plumbago zeylanica* L. (43.60%), *Terminalia chebula* (Gaertn.) Retz. (42.85%), *Emblica officinalis* Gaertn. (36.84%) and *Terminalia bellerica* (Gaertn.) Roxb. (26.31%).

DISCUSSION

Evidence for Western medicine (4) suggest that the four major types of heart diseases discribed in Ayurveda may be groups of known cardiac ailments, *krimija hrdroga* being comparable to effective endocarditis. However, further research is required to clarify this point.

During the course of this survey, it was observed that in addition to the specific formulations prescribed in the sections on therapeutics of heart disease, almost every chapter of a text contained some useful data or formula which included heart disease among its many indications. For example, *Susruta* states in the chapter on the aetiology of urinary disorders of polyuric nature (*prameha*) that heart disease can be its secondary affliction. Moreover, in the chapters on the classification of abscess (*vidradi*), *Susruta* and *Vagbhata* describe *Hrdayavidradhi* (5,6). It will be rewarding to ascertain whether the disease has any semblance with various tumours of the heart (7). It is therefore evident that a text needs to be surveyed in its entirety for gathering information on any specific point.

The present survey of ayurvedic texts has revealed numerous single and multiple component formulations for heart disease. However, in many instances the formulations are simply said to cure heart disease, no hints being given on the sub - group of the disease for which they are specially effective. Thus comparative clinical studies and comprehensive knowledge of the ayurvedic concepts of drug design are essential to evaluate the therapeutic utility of these formulations. Such studies will further the widespread use of ayurvedic medicines in the treatment of various types of heart disease described in Western medical literature.

References

(1) KUMAR D.S., PRABHAKAR Y.S., (1987) *J. Ethnopharmacol.* 20: 173 -190.
(2) PRABHAKAR Y.S., KUMAR D.S., (1988) *Plant. med. Phytother.*, 22: 173 -190.
(3) PRABHAKAR Y.S., KUMAR D.S., (1990) *Fitoterapia* (in press).
(4) ANDERSON J.R., (1985) in Muir's Textbook of Pathology (Anderson J.R ed.). pp. 15.1-15.45, E. L. B. S./ Edwin Arnold, London.
(5) ATREDEV (1975) *Susruta Samhita*, p. 256. Motilal Banarsidas, Delhi, India.
(6) UPADHYAYA Y., (1975) *Astangahrdaya*, p. 258. Chaukhamba, Sanskrit, Sansthan, Varanasi, India.
(7) COLLUCCI W.S., BRAUNWALD E., (1984) in *Heart Disease* (Braunwald E. ed.), vol. 2, pp. 1457-1469, W. B. Saunders and Co., Philadelphia.

Sample of Replies to Questionnaires to Herbal and Pharmaceutical Companies

Name : P. DORFMAN, M.D.
Medical research department
Company : DOLISOS Laboratories
Address : 71 rue Beaubourg, F-75003 PARIS

Types of products manufactured/marketed :

1) Yes. Preparation of mother tinctures used in homoeopathy

2) Piper angustifolium - Piper cubeba - Piper nigrum - Piper methysticum.

3) Ethanolic extracts (about 70° alcohol) for preparation of homoeopathic remedies.

4) Less than 5 kg/year for each specie.

5) Not included in OTC product formula. Medical prescription only.

6) Based on pathogenesic symptoms : sexual excitement (priapism), dryness and burning of nose, sneezing... (cf Voisin's Materia medica).

7) Homoeopathic remedies are prepared with a very small quantities of extracts (few µg). So, we need few

8) 10 - 50 liters corresponding to 1 kg - 5 kg of plants.

9) None clinical or pharmacological researches have been done (in my opinion) in homoeopathy since the first pathogenesia conducted by Houat in 1868.
None toxicological studies have been performed because the concentration of peper is very low.

10) We never made medline concerning piperine on anti convulsive and vasodilatorial properties. The effects observed with piper on nervous system (excitation cf article of Verger and Anthony in annex) and on sexual organs (priapism) could be related to this active principle.
INIST (a data bank on natural products and plants) gives us only 2 references (cf annex) on cardiovascular effects and biological activities in mammalian systems. We notice that Piper nigrum an effect on lactation as mentioned in Voisin.'s book. We send you also a copy of Kumar and Praghakar's paper on "Surveying of sanskrit medical texts for cardiological information" where Piper longum and Piper nigrum are are noticed as a main components of Ayurvedic formulation for heart diseases.

11) Our research Department did never studied on this topics. A lot of plants have been described to have a very good efficiency as antihelmintic and antiinflammatory, certainly more than pepper. It seems better to base your research on ethno-pharmacological approach.
We suggest to contact the European Society of Ethnopharmacology (att. Dr. J. Fleurentin, 1 rue des Récollets, F-57000 METZ, fax: 33 87 36 41 98)

12 to 22 (?) problem with fax : I have no comment about these questions.. All of them are focused on piperine and piperine dérivatives which have never studied.

Section IV : Future developments

No prospective for the moment. No proposition to suggest.

Samples of Questionnaire and Interviews with University Specialists (2)

QUESTIONNAIRE ON PEPPER
(PIPER NIGRUM L)
(UNIVERSITIES & RESEARCH ORGANIZATIONS)

SECTION I: PRODUCT AND COMPANY INFORMATION

Name:

Position:

University:

1) In what products are black and white pepper or pepper extracts normally used in the pharmaceutical and herbal industries?

2) What types of pepper are used?

3) What types of pepper extracts are used?

4) What quantities of black/white pepper and pepper extracts are used in the pharmaceutical and herbal industries?

5) In which products are they used?

6) What are the different uses and applications of the products?

7) What quantities of black/white pepper and pepper extracts are used by each relevant medicine type?

8) Rank the uses of black/white pepper/pepper extracts in terms of their importance, based on the quantities required.

9) Have clinical and toxicological studies been conducted on these pepper products that validate their efficacy and safety?

10) What is your opinion concerning the anticonvulsive and vasodilatorial properties of piperine and piperine derivatives?

11) What are your comments about piperine and piperine derivatives in synthesis with other natural plant extracts in use as an anthelminthic and antiflammatory, including consideration of:

- reliability in the pharmaceutical and herbal medical industries.
- the actual applicability of the reported behaviour.

12 a) Are there any other uses of black/white pepper/pepper extracts currently being researched, developed or considered?

b) What are these possible uses?

c) At what stage of development are they?

d) How long will it be until they are fully developed?

13) What are the properties of pepper and pepper extracts?

14) What are other possible uses, in the pharmaceutical industry, for black/white pepper/pepper extracts?

15) What are the methods of extraction of components of pepper for use in the pharmaceutical industry?

16) What are the methods of isolation/ separation of components of pepper for use in the pharmaceutical industry?

17) What are the costs of extracting/isolating the various useful components of pepper, using the various processes and technologies currently available?

18) Rank the processes and technologies for extraction and isolation/separation by:

- cost
- quality
- reliability
- efficacy
- speed
- quantity

19) Have there been any recent advances and trends in the extraction and isolation/separation processes with a view to future developments in this technology?

20) a) Are you aware of any synthetic products that are used as substitutes/competitors to pepper in the pharmaceutical/herbal industry?

If so:

b) What are these products?

c) Who are the main suppliers of these products?

d) What is their
- quality?
- efficacy?
- price?
- availability?

21) a) What is the market for black/white pepper/pepper derivatives which are further processed for supply to the pharmaceutical industry through technologies

not currently available to suppliers in the developing countries?

b) What are these processes? Please give a brief description.

What is the market price for these products after further processing?

SECTION II: FUTURE DEVELOPMENTS

What future developments are likely to take place in the research and development field for black/white pepper and pepper extracts?

Do you think it is likely that the cost of extraction and isolation for pepper and pepper extracts could be reduced by technological development in the next 5-10 years?

How do you think the relative demand and strength of pepper and its synthetic competitors will change with technological developments?

What databases are available concerning black/white pepper and its derivatives?

20/9/95

PLEASE SEND ME A COPY OF THE REPORT.

With Compliments

FACULTY of SCIENCE

Department of Pharmaceutical Sciences

School of Pharmacy

Dr M Aslam LLM MSc PhD FRPharmS MCPP Course Director in Clinical Pharmacy

University Park Nottingham NG7 2RD UK Telephone (0115) 951 5060
Facsimile (0115) 951 5102 E-Mail M.Aslam@Nottingham.ac.uk

QUESTIONNAIRE ON PEPPER

Dr M Aslam LLM MSc PhD FRPharmS MCPP
Course Director in Clinical Pharmacy
Department of Pharmaceutical Science
University of Nottingham, NG7 2RD

2. Piper nigrum (Pippali), Piper Retrofractum

3. Volatile Oils and Lignans

4. Many Tons

5. Unani Medicine - Piper Longum

6. Pungent Qualities, Nerve Tonic, Asthma, Cough, Fever, Piles and Gonerrhoea

7. Many Tons

8. First - Singapore
   Second - Bengali (P. Longum)
   Third - Swaheli (from Zanzibar)

9. No

10. More detailed studies required.

11. Not sufficient data.

12b. Irritating Snuffs & Tonic in Paraplegia
12c. N/K
12d. Don't Know

13. Catarrh, Infusion used as tonic in Paraplegia Liniment, it is applied to bites of venomous reptiles.

14. N/A

19. YES

20. No

THE UNIVERSITY
of MANCHESTER

Brian Lockwood
BPharm, PhD, MRPharmS
Legal and Commercial Consultant
Aromatherapy, Plant Drugs, Cosmetics,
Drugs of Abuse

Department of Pharmacy

The University of Manchester
Manchester M13 9PL UK
Tel 061-275 2399
Fax 061-275 2396
EMail BLockwood@fs1 pa man ac uk

Questionnaire on Pepper

G.B.Lockwood
Department of Pharmacy,
University of Manchester,
Manchester M13 9PL

1.For flavouring and as a carminative in herbal remedies.
2.Predominantly Piper nigrum.Capsicum plus other Piper spp. are also used.
3.Oleoresin (acetone extract in the UK , ether in the US),and water, ethanol/methanol extracts,plus the essential oil (produced by distillation).This latter extract is used predominantly for flavouring.
4.Insignificant amounts.
5.See 1.
6.No products containing pepper solely or predominantly.
7.Insignificant.
8.n/a.
9.No.
10.Unlikely to be developed as pharmaceuticals.
11.Most unlikely to be developed as pharmaceuticals.
12.a)Many applications are being researched.
b)Chemoprotective for chemical carcinogenesis.
c)Pre-develop ment.
d)Probably never.
13.Irritant and warming, plus those mentioned in 1.,10.,11.,&12.
14.Flavouring as used in brandy.
15.Traditional solvent extraction (see 3.), plus more recently supercritical fluid extraction (SFE) with carbon dioxide.
16.As above when applicable.
17.Capital outlay for supercritical fluid extraction is much higher, but running costs of solvent extraction are much higher.
18.Cost-see 17.
Quality-SFE greater than solvent.
Reliability- not known.
Efficacy-this obviously depends upon the conditions used.

Speed-SFE greater than solvent.
Quantity-considering the demand this is not a serious consideration.

19.SFE is more widely being used.
20.No.It would be most unlikely.
21.Minimal if at all.
22.n/a

Section II

1.See 13.
2.Most unlikely.
3.No.
4.Medline,Pharmaprojects,Napralert,Datastar-Tradstat,Eurostat Material,Chemical Abstracts.FAO and EU databases are available which list export/import figures for pepper/peppers,essential oil, and oleoresins.

Companies Contacted for Study on the Applicability of Pepper or Piperine in Pharmaceutical Products

ABBOT LAB LTD. UK	(don't use pepper)
ABKIT INC. (owned by ASTA MEDICA, Germany) 130 E. 93rd St. NY, NY 10128 USA Tel.: 001 212 860 8358 Fax: 001 212 860 8323	Andrew Fischman Director, Sales & Mktg.
ADVANCED PHYTONICS LTD. Production Centre Cowfold Grange Leeming UK DL7 9SY Tel.: 01677 425 655 Fax: 01677 425 184	Peter F. Wilde Technical Director
BAYER UK LTD. Bayer House, Strawberry Hill Newbury, Berks. RG13 1JA UK Tel.: 01635 39000 Fax: 01635 563404	Ian Dorrian Medical Information (use Capsicum derivatives only)
BAYWARD PHARMACEUTICALS UK	(don't use pepper)
BEIERSDORF AG Unnastr. 48 20253 Hamburg, GERMANY Tel.: 00 49 40 5690 Fax: 00 49 40 569 3434	
BEIERSDORF SPAIN Tel.: 00 34 37 858 3300 Fax: 00 34 37 58 3465	Mr. Fonuet, Purchaser
BERK PHARMACEUTICALS UK	(don't use pepper)
BERRY OTTAWAY & ASSOC. UK Fax: 01432 270808	Mr. P. Ottaway Managing Dir.
BODY SHOP LTD. UK Tel.: 01903 731500	Lucy Moore Customer Services Mgr. Use paprika extract & capsicum extract

BOEHRINGER INGELHEIM FRANCE 6 rue Leo Delibes 76116 Paris, FRANCE Tel.: 00 33 1 4553 5815 Fax: 00 33 1 4553 3076	Mrs. Biard Medical Info. Off. (don't use pepper)
BOEHRINGER MANNHEIM GERMANY Mannheim, GERMANY Tel.: 00 49 621 7590 Fax: 00 49	Mr. Hennig, Purchaser
BRISTOL MYERS SQUIBB PHARMA LTD. UK	(don't use pepper)
CANTASSIUM CO. UK	(don't use pepper)
CIBA GIGY UK	(don't use pepper)
CIBA GEIGY LABORATOIRES SA 2 rue Terray 92506 Rueil Malmaison Cedex, FRANCE Tel.: 00 33 1 4752 3000 Fax: 00 33 1 4752 8515	
CILAG LTD. UK	(don't use pepper)
CLARINS France Tel.: 00 33 1 49 47 38 1212	Charlotte Smith (don't use pepper)
COLGATE-PALMOLIVE LTD. Guildford Bus. Park Middleton Rd. Guildford, Surrey UK Tel.: 01483 30 22 22 Fax: 01483 464 447	Beverly Palmer Consumer Relations
CYYAMID (UK) LTD. UK	(don't use pepper)
DANSKE DROGE A/S DENMARK	(don't use pepper)
DOLISOS LABORATOIRES 71, rue Beaubourg 75003 Paris, FRANCE Tel.: 00 33 1 44 78 11 39 Fax: 00 33 1 42 71 58 96	Dr. Pierre Dorfman M.D., Medical Dept. (use 4 species of pepper, incl. piper nigrum)
DUMAS UK LTD. Unit B7, Lakeside Park Medway City Estate Rochester, Kent ME2 4LT UK Tel.: 01634 297171 Fax: 01634	Mr. Roy Erwood

ELF-ATOCHEM FRANCE Tel.: 00 33 1 49 52 5600	Mr. Ardunee Commercial Asst. (don't use pepper)
EISAI EUROPE LTD. UK	(don't use pepper)
ELIDA-GIBBS GmbH Hamburger Str. 23 22083 Hamburg GERMANY Tel.: 00 49 40 22 66 50, Ext. 243	Mrs. Prior Raw Materials & Perfumes Mgr./ Central Buying Dept.
ELIDA-GIBBS LTD. Hesketh Ho. 43/45 Portman Sq. London W1A 1DY Tel.: 00 44 171 486 1200 Fax: 00 44 171 409 63 04	
EMIL FLACHSMANN Butzenstrasse 60 Postfach 489, CH-8038, Zurich, SWITZERLAND Tel.: 00 41 1482 1555 Fax: 00 41 1482 3444	Mr. Gottfried Research & Development (don't use pepper)
ENGLISH GRAINS, UK Fax: 01225 751314	Anthony Dweck (use capsicum)
EURODERMA LTD. UK Tel.: 0181 974 2266 Fax: 0181 974 2005	Tim Lovett (don't use pepper)
EVANS MEDICAL UK	(don't use pepper)
FERROSAN Sydmarken 5 DK-2860 Soeborg DENMARK Tel.: 00 45 3969 2111 Fax: 00 45 3969 6518	Harry Ebison, Head Purchasing Dpt. (don't use pepper)
FISONS PHARMACEUTICALS plc Pharmaceutical Division Coleorton Hall Ashby Rd., Coleorton Coalville, Leics. LE67 8GP Tel.: 01509 634000 Fax: 01530 560330	Eleanor Hood BA MSc MIInfSc Sr. Med. Info. Off. (don't use pepper or its derivatives)

FLORINA Ettau 49670 Valanjou FRANCE Tel.: 00 33 4179 7241 Fax: 00 33 41 797989 / 4145 4995	Christienne Le Petit Commercial Mgr. Annie Cesbron (her deputy) said they use approx. 1 kilo per year of black and white pepper in products.
FRAGRANCE OILS (INTERNATIONAL) LTD. Eton Hill Ind. Est. Eton Hill Rd. Radcliffe, Manchester U.K. Tel.: 00 44 161 724 9311 Fax: 00 44 161 724 7220	Phillip Harris, Perfumery Director (Has small stock of black pepper; uses distilled black pepper oil in fragrances; costs vary; minimal amounts used; distributor is from France but they use more than one source.)
GEHRLICHER GmbH & Co. GERMANY	(don't use pepper)
GENERICS (UK) LTD. UK	(don't use pepper)
GIVAUDAN-ROURE 55 Voiedes Bans BP 24 95 102 Argenteuil Cedex FRANCE Tel.: 00 33 1 39 98 1515 Fax: 00 33 1 39 98 1705	Mr. P.E. Camen Synthetics Dept. Faxed quest.; awaiting response from Flavours, Fragrances & Syn. Depts.
GLAXO WELLCOME PHARMACEUTICALS UK LTD. Glaxo Holdings PLC, Clarges House, 6-12 Clarges St., London W1Y 8DH UK Tel.: 0171 493 4060	Dr. Jane Lewis Head of Research & New Product Dpt. Discovery Technology Medicines Research Ctr., Gunnel Wood Rd., Stevenage, Herts. SGM 2NY (don't use pepper)
HARRAS-PHARMA-CURARINA ARZNEIMITTEL GmbH Am Harras 15, D-81373 Munchen, GERMANY Tel.: 00 49 89 763052 Fax: 00 49 89 721 2653	Mrs. Ingrid Zobel Scientific/Medical Consultant (on leave) Mrs. Mueller, Pharmacist (don't use pepper)
HOECHST UK LTD. Pharmaceutical Division Hoechst House, Salisbury Rd. Hounslow, Middlesex TW4 6JH Tel.: 0171 570 7712	(don't use pepper)

HOECHST (herbal medicines)
Bruningstr. 50
Hoechst 65929
Frankfurt, GERMANY
Tel.: 00 49 69 3050
Fax: 00 49 69 30 3666

HOLISTICA INTERNATIONAL (don't use pepper)
FRANCE

ICI (sold to ZENECA -- see ZENECA)
UK

ICN BIOMEDICALS (don't use pepper)
UK

INTERPHARM APS
Industri Aparkean 4
DK-2750 Ballieup
DENMARK
Tel.: 00 45 4466 8008
Fax: 00 45 4466 8808
Gida Peterson
Director
(don't use pepper)

IPSEN INTERNATIONAL (don't use pepper)
UK

J. PICKLES & SONS
Beech House
62 High St., Knaresborough
N. Yorkshire HG5 0EA
UK
Tel.: 01423 867314
Fax: 01423 869177
Mr. Colin Smales
Prod. Mgr.
(only use 35 kilos of capsicum BC powder per year)

JOHNSON & JOHNSON
Foundation Park
Roxborough Way
Maidenhead, Berks.
SL6 3UG
UK
Tel.: 00 44 1628 82 22 22
Fax: 00 44 1628 82 68 18
Ms. Sandy Stevenson
Info. & Regulatory Affairs Mgr.
(don't use pepper)

KNGPP
GERMANY
Fax: 00 49 931 2162
Mr. Bocker

KNIEPP WERKE
Kneipp-Mittel-Zantrale
Steinbachtal 43
D-97082 Wurzburg
Tel.: 00 49 931 800 20
Fax: 00 49 931 800 2162
Dr. R. Wohlfart
Export Section
(don't use pepper/extracts)

KNOLL AG
Knollstr. 50
67061 Ludwigshafen
GERMANY
Tel.: 00 49 621 5890
Fax: 00 49 621 589 2896
Myles Chandler

(Direct line: 00 49 621 589 3174)

KREWEL-WERKE GmbH 53783 Eitorf, GERMANY Tel.:00 49 224 3870 Fax: 00 49 22 43 871 75	Dr. Robert Hofmann (use piper methysticum [= kava] & spissum [dry] pepper extracts)
LABORATOIRES D'HERBORISTERIE GENERALE (L.H.G.) 269 rte 3 Lucs a la Valentine 13011 Marseille, FRANCE Tel.: 00 33 91 43 2631 Fax: 00 33 91 43 1405	Mr. Rojon Fax: 00 33 91 43 1405
LABORATOIRES IEHNING FRANCE	(don't use pepper)
LARKHALL NATURAL HEALTH LTD. 225 Putney Bridge Rd. London SW15 2PY Tel.: 0181 874 1130 Fax: 0181 871 0066	Dr. Woodward (don't use pepper)
LIPHA PHARMACEUTICALS LTD. UK	(don't use pepper)
MARION MERELL	Dr. Masheter
MEZINA NATUR PRODUKTER Aps	(don't use pepper)
MITCHFIELD BOTANICS Tel.: 01202 433691	Hugh Mitchfield
MUEGGENBURG FRANCE HERBOSUD SAR L 39 chem Moulin Carron 69570 Dardilly, FRANCE Tel.: 00 33 78 47 5554 Fax: 00 33 78 43 2708	Mr. Garjon, Director. Chantal Frezet, Asst. to Dir. & Purchaser of Raw Materials said they don't use black/white pepper.
NESTMANN & CO. GERMANY Tel.: 00 49 9547 92210	Mr. Nestmann
NINA RICCI Paris, FRANCE Tel.: 00 33 1 49 52 5600	(don't use pepper but fragrance oil suppliers sometimes do, like: IFF Int'l (US), Creations Aromatique, Paris, Givaudan-Roure, Roure Bertrand (Paris)
NOVO NORDISH PHARMACEUTICALS UK	(don't use pepper)
PLANTES ET MEDICINES FRANCE	(don't use pepper)

RECKITT & COLMAN PLC Dansom Lane Hull HU8 7DS, UK Tel.: 01482 26151 also London office: Tel.: 0181 994 6464	(don't use pepper)
RHONE-POULENC-RORER RPR House, 52 St. Leonard's Rd. Eastbourne, E. Sussex BN21 34G, UK Tel.: 01323 534000 Fax: 01323 534086	Julie Everitt Medical Info. (will only answer yes/no questions)
ROCHE CONSUMER HEALTH, UK Tel.: 01707 366 000 Fax: 01707 391 503	Mary Wheeler Medical Servc. Mgr. (use Capsicum and pepper resin extracts)
SMITHKLINE BEECHAM PLC Harlequin Ave., Brentford, Middlesex TW8 9EP UK Tel.: 0181 975 2000 Fax: 0181 975 2130	Dr. Christopher Stewart (don't use pepper)
UNITED MEDICINAL PLANTS FRANCE	(don't use pepper)
WELEDA UK LTD. Fax: 0602 440 349	Mr. Peter Mills Control Analyst (use Capsicum Annum)
WELLA UK UK Tel.: 00 44 1268 522711	Ms. Leslie
WELLCOME PLC Unicorn Ho., 160 Euston Rd. London NW1 2BP UK Tel.: 0171 387 4477 Fax: 0171 388 3530	now owned by GLAXO
WHITEHALL LABORATORIES, UK Huntercombe Lane South Taplow, Berkshire SL6 0PH Tel.: 01628 669011 Fax: 01628 414870	Mrs. Melanie Eatough BSc MrPharmS Medical Info. Mgr. (use Capsicum)
YARDLEY LENTHERIC GROUP 4 Miles Gray Rd. Basildon SS14 3BZ Tel.: 01268 522711 Fax: 01268 28 22 28	Arlene Kelly, Buyer (don't use pepper but a pepper oil extract is used in fragrance industry)
ZENECA PHARMACEUTICALS UK Tel.: 01625 512285	(took over ICI, UK) (Call Sec. to head of Manufacturing Dept.)

August 17 1995
Search on BIDS Science Citation Index Database using search terms *Piper nigrum* and *Piper longum* to cover the period 1981-present.

Carried out by Dr Amala Raman, Department of Pharmacy, King's College London, Manresa Road, SW3 6LX.

Piper nigrum

Record - 1

TI- ELEMENTAL COMPOSITION OF GLOBOIDS IN THE PERISPERM TISSUE OF VARIOUS SEEDS
AU- WEST. MM;FLANNIGAN. DT.LOTT. JNA
NA- MCMASTER UNIV.DEPT BIOL.1280 MAIN ST W.HAMILTON.ON L8S 4K1.CANADA
JN- CANADIAN JOURNAL OF BOTANY-REVUE CANADIENNE DE BOTANIQUE
PY- 1995
VO- 73
NO- 6
PG- 954-957
IS- 0008-4026
DT- Note
AB- The mature seeds of some angiosperms contain perisperm tissue derived from remains of the nucellus tissue of the ovule. In our transmission electron microscopy studies, the perisperm tissues of the seeds of Yucca brevifolia, Coffea arabica, Beta vulgaris, Piper nigrum, and Zostera capricorni contained naturally electron-dense globoids. Energy dispersive X-ray analysis of globoids from the perisperm tissues of these seeds revealed varying levels of phosphorus, potassium, magnesium, and calcium, results that are consistent with the presence of the mineral nutrient store called phytate. Phosphorus, potassium, magnesium, calcium, and other mineral nutrients, likely stored as phytate, have routinely been located in globoids of endosperm, female gametophyte, and embryo tissues of seeds.

Record - 2

TI- ESTIMATION OF PHENOLIC-COMPOUNDS IN GREEN-PEPPER BERRIES (PIPER-NIGRUM L) BY HIGH-PERFORMANCE LIQUID-CHROMATOGRAPHY
AU- VARIYAR. PS;BANDYOPADHYAY. C
NA- BHABHA ATOM RES CTR.DIV FOOD TECHNOL & ENZYME ENGN.BOMBAY 400085.MAHARASHTRA.INDIA
BHABHA ATOM RES CTR.DIV FOOD TECHNOL & ENZYME ENGN.BOMBAY 400085.MAHARASHTRA.INDIA
JN- CHROMATOGRAPHIA
PY- 1994
VO- 39

NO- 11-12
PG- 743-746
IS- 0009-5893
DT- Note
AB- An HPLC method is described for the separation and estimation of phenolic compounds in six commercial varieties of green pepper berries. Among these, two phenolic compounds namely 3,4-dihydroxyphenylethanol glucoside and 3,4-dihydroxy-6-(N-ethyl amino)benzamide that served as efficient substrates for pepper phenolase, showed wide qualitative and quantitative variation in their composition within the varieties. Quantitative estimations of these two compounds were carried out using 4-methylcatechol and epinephrine as external standards. This method is suitable for the estimation of phenolic compounds in green pepper berries in one run.

Record - 3

TI- INFLUENCE OF SPICES ON PROTEIN-UTILIZATION OF WINGED BEAN (PSOPHOCARPUS-TETRAGONOLOBUS) AND HORSEGRAM (DOLICHOS-BIFLORUS)
AU- PRADEEP, KU;GEERVANI, P
NA- AP AGR UNIV,FAC HOME SCI,POSTGRAD & RES CTR,HYDERABAD 30,INDIA
AP AGR UNIV,FAC HOME SCI,POSTGRAD & RES CTR,HYDERABAD 30,INDIA
JN- PLANT FOODS FOR HUMAN NUTRITION
PY- 1994
VO- 46
NO- 3
PG- 187-193
IS- 0377-3205
AB- The influence of a mixture of eleven spices commonly consumed in India on the utilisation of protein from boiled winged bean (Psophocarpus tetragonolobus) and horsegram (Dolichos biflorus) was studied at 10 and 20 percent level of protein intake in experimental rats. Spices used in the mixture include red chillies (Capsicum annum), black pepper (Piper nigrum), coriander (Coriandrum sativum), cumin (Cuminum cyminum), garlic (Allium sativum), ajowan (Carum copticum), turmeric (Curcuma longa), caraway seeds (Carum carui) and fennel seeds (Foeniculum vulgare). Addition of this spice mixture at 1.5% level of the diet decreased the TD of both legumes, significantly only in the case of horsegram. A significant increase was observed in the BV of both the legumes at both levels of protein tested.

Record - 4

TI- CONCISE, EFFICIENT NEW SYNTHESIS OF PIPERCIDE, AN INSECTICIDAL UNSATURATED AMIDE FROM PIPER-NIGRUM, AND RELATED-COMPOUNDS
AU- STRUNZ, GM;FINLAY, H
NA- CANADIAN FOREST SERV,POB 4000,FREDERICTON E3B 5P7,NB,CANADA
JN- TETRAHEDRON
PY- 1994
VO- 50

NO- 38
PG- 11113-11122
IS- 0040-4020
AB- Piperoide and piperolein A, unsaturated amides from Piper nigrum, were prepared in overall yields of 21% and 35% respectively, by a new, short and efficient strategy, in which the key step was the aldol-Grob-type fragmentation sequence recently reported by Sakai et al., (but using propylene- rather than ethylene glycol). The nor-homologues of these natural products were similarly prepared. In the final steps, the amides could be prepared directly from the esters by Roskamp's method involving treatment with Sn(N(TMS)(2))(2) and the appropriate amines, or from the corresponding carboxylic acids by conventional methodology.

Record - 5

TI- ANTIBACTERIAL ACTIVITY OF ALIMENTARY PLANTS AGAINST STAPHYLOCOCCUS-AUREUS GROWTH
AU- PEREZ, C;ANESINI, C
NA- UNIV BUENOS AIRES,FAC ODONTOL,CATEDRA FARMACOL,MT DE ALVEAR 2142,RA-1122 BUENOS AIRES,ARGENTINA
JN- AMERICAN JOURNAL OF CHINESE MEDICINE
PY- 1994
VO- 22
NO- 2
PG- 169-174
IS- 0192-415X
AB- Alimentary plants were screened for antibacterial activity against a penicillin G resistant strain of Staphylococcus aureus. Twenty-five samples of plant material corresponding to 21 species from 13 families were used. Both aqueous and ethanol extracts were obtained from them. Antibacterial activity was determined by the agar-well diffusion method, using cephazolin as a standard antibiotic. Seventeen ethanol extracts were found active. Eugenia caryophyllata (clavo de olor*) flowers, Myristica fragans (nuez moscada*) seeds, Theobroma cacao (cacao*) seed bark, Triticum sp (trigo*) fruit, Zea mays (maiz*) fruit and Piper nigrum (pimienta*) ripe fruit produced some of the more active extracts (* = Argentine vulgar names).

Record - 6

TI- RESINIFERATOXIN AND PIPERINE - CAPSAICIN-LIKE STIMULATORS OF OXYGEN-UPTAKE IN THE PERFUSED RAT HINDLIMB
AU- ELDERSHAW, TPD;COLQUHOUN, EQ;BENNETT, KL;DORA, KA;CLARK, MG
NA- UNIV TASMANIA,DEPT BIOCHEM,GPO BOX 252C,HOBART,TAS 7001,AUSTRALIA
UNIV TASMANIA,DEPT BIOCHEM,HOBART,TAS 7001,AUSTRALIA
JN- LIFE SCIENCES
PY- 1994
VO- 55

NO- 5
PG- 389-397
IS- 0024-3205
AB- The naturally occurring capsaicin-like molecules, resiniferatoxin (RTX, Euphorbia spp.) and piperine (Piper nigrum), each stimulated oxygen uptake (VO2) in association with increased vascular resistance in a concentration-dependent manner when infused into the perfused rat hindlimb. 5 mu M glyceryl trinitrate (GTN, a nitrovasodilator) significantly blocked the oxygen and pressure responses to both RTX and piperine, indicating a close relationship between changes in VO2, and the vasoconstriction. Concentrations greater than those required for maximal VO2 resulted in an inhibition of VO2, although perfusion pressure continued to increase. Time course studies showed that both RTX and piperine at high doses resulted in a tri-phasic response. An initial phase of transient VO2 stimulation was followed by a second phase of inhibition. A third phase involving an often larger but transient stimulation of VO2 followed removal of the agents and continued after the pressure returned to basal. The actions of RTX and piperine were similar to those of other active capsaicin-like molecules tested previously in this system, including capsaicinoids (Capsicum spp.), gingerols (Zingiber officinale), and shogaols (Zingiber officinale). RTX was the most potent, and piperine the least potent of this series. Although receptor involvement has yet to be unequivocally established, the data are consistent with the presence of a functional capsaicin-like (vanilloid) receptor in the vasculature of the rat hindlimb that mediates vasoconstriction and oxygen uptake. These findings may have implications for the future development of thermogenic agents.

Record - 7

TI- GERMINATION STUDIES AND CRYOPRESERVATION OF SEEDS OF BLACK PEPPER (PIPER-NIGRUM L) - A RECALCITRANT SPECIES
AU- CHAUDHURY, R;CHANDEL, KPS
NA- NBPGR,NATL PLANT TISSUE CULTURE REPOSITORY,NEW DELHI 110012,INDIA
JN- CRYO-LETTERS
PY- 1994
VO- 15
NO- 3
PG- 145-150
IS- 0143-2044
AB- Seeds of Piper nigrum showed high moisture at shedding. They withstood desiccation down to 12% moisture content but viability loss increased with reduction in moisture level below 12%. Pepper seeds desiccated to 12% and 6% moisture content were successfully cryopreserved with survival rates of 45% and 10.5%, respectively i.e. 79% and 50% of desiccation control.

Record - 8

TI- CROWN DEVELOPMENT AND BIOMASS PRODUCTION OF POLLARDED ERYTHRINA-BERTEROANA, E-FUSCA AND GLIRICIDIA-SEPIUM IN THE HUMID TROPICAL LOWLANDS OF COSTA-RICA

AU- MUSCHLER, RG;NAIR, PKR;MELENDEZ, L
NA- CATIE GTZ,PROYECTO AGROFORESTAL,APDO 126,CATIE 7170,COSTA RICA
JN- AGROFORESTRY SYSTEMS
PY- 1993
VO- 24
NO- 2
PG- 123-143
IS- 0167-4366
AB- Leguminous trees are widely used to support climbers such as black pepper (Piper nigrum L.) and vanilla (Vanilla planifolia Andr.), to provide shade to crops and to maintain soil fertility. Pruning or pollarding provides the means to maximize benefits from the trees, particularly through the production of biomass as a soil amendment. At the same time, excessive shading is reduced. In order to quantify the degree of shading of black pepper by the support trees during a six-month pollarding cycle, this study monitored crown development (part I) and light transmission (part II) of three widely used species, Erythrina berteroana Urban, E. fusca Loureiro and Gliricidia sepium (Jacq.) Steud.
The two sites were in the humid Atlantic Lowlands of Talamanca, southern Costa Rica (mean annual rainfall 2460 mm, no distinct dry season), on alluvial soils (typic Tropofluvents) with low levels of K, P, Mn and Zn. Two-year-old trees, that had been established from cuttings as live supports for black pepper, were used for the study. They were pollarded twice per year. The variables measured/estimated monthly were: stem diameter at breast height (dbh); height, foliated height, depth, diameter, leaf area and leaf biomass of crowns; length, diameter, number and inclination of branches. Leaf nutrient contents were also determined.
Following pollarding, G. sepium was the first to resprout, followed by E. berteroana and E. fusca. G. sepium with its few but erect and long branches had slender, columnar crowns, while those of E. berteroana and E. fusca were more spherical. Four months after pollarding, G. sepium started shedding leaves at the base of its branches. Average crown diameter after six months were 2.2 m for E. berteroana, 1.9 m for E. fusca and 1.5 m for G. sepium; average crown depths after six months were 2.8 m, 2.1 m, and 2.7 m, respectively, for the three species. For 1600 trees ha(-1) and two prunings per year, foliar biomass production from prunings alone (i.e., without litter fall), calculated from regressions with length and basal diameter of branches as independent variables, was 3.8 t, 3.4 t and 2.3 t dry matter ha(-1) a(-1) for E. berteroana, E. fusca and G. sepium, respectively; these estimates agreed well with measured values. The corresponding N contents were 146 kg, 124 kg and 90 kg, respectively. While N contributions from the prunings exceeded 50% of the fertilizer recommendations for black pepper, the contributions were <10% for P and <40% for K. Linear regressions between leaf area and branch dimensions, and quadratic regressions between foliar biomass and crown diameter showed high coefficients of determination (0.83 > R(2) > 0.99). Correlations between foliar biomass, dbh, and dbh increments were generally weak. Conclusions from the study appear to be valid also for other agroforestry systems where the same

species are planted under simular ecological conditions for reasons other than as live supports.

Record - 9

TI- THE USE OF REVERSE-PHASE C-18-BONDED SILICA FOR THE TRAPPING. CONCENTRATION AND ANALYSIS OF HEADSPACE VAPOR FROM MODEL ORGANIC-COMPOUNDS. BANANA PSEUDOSTEM AND BLACK PEPPER
AU- NDIEGE. IO;OTIENO. DO;BUDENBERG. WJ;HASSANALI. A
NA- INT CTR INSECT PHYSIOL & ECOL.POB 30772.NAIROBI.KENYA
JN- JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE
PY- 1994
VO- 64
NO- 1
PG- 47-52
IS- 0022-5142
AB- A study of recovery efficiency of a series of volatile compounds trapped on reverse-phase C-18-bonded silica has shown that reverse-phase silica is a useful addition to the existing range of adsorbents available for headspace volatile concentration and analysis. A gas chromatograph comparison of the airborne volatiles from black pepper (Piper nigrum) and banana pseudostem (Musa sp) recovered from reverse-phase silica, activated charcoal and Porapak Q traps shows no qualitative differences in the components present.

Record - 10

TI- SEASONAL INCIDENCE OF HEXAMERMIS-SP (DOR-MERMITHIDAE) PARASITIZING LARVAE OF TOP SHOOT BORER CYDIA-HEMIDOXA MEYR (LEP-TORTRICIDAE) ON BLACK PEPPER
AU- DEVASAHAYAM. S;KOYA. KMA
NA- NATL RES CTR SPICES.POST BOX 1701.MARIKUNNU PO.CALICUT 673012.INDIA
JN- JOURNAL OF APPLIED ENTOMOLOGY-ZEITSCHRIFT FUR ANGEWANDTE ENTOMOLOGIE
PY- 1994
VO- 117
NO- 1
PG- 31-34
IS- 0931-2048
AB- The entomophagous nematode Hexamermis sp. was recorded for the first time parasitising larvae of top shoot borer Cydia hemidoxa Mevr. on black pepper Piper nigrum L. at Peruvannamuzhi (Calicut District, Kerala State) in India. The incidence of parasitism was observed in the field during June to November and was high during July and August; up to 76.7 % of larvae were parasitised during August 1991. A highly significant and positive correlation was observed between incidence of parasitism and rainfall. Hexamermis sp. appears to play an important role in the natural control of C. hemidoxa on black pepper.

Record - 11

TI- EFFECT OF TOP SHOOTBORER (CYDIA-HEMIDOXA) INFESTATION ON YOUNG VINES OF BLACK PEPPER (PIPER-NIGRUM)
AU- DEVASAHAYAM. S;KOYA. KMA
NA- NATL RES CTR SPICES.MARIKUNNU.CALICUT 673012.KERALA.INDIA
JN- INDIAN JOURNAL OF AGRICULTURAL SCIENCES
PY- 1993
VO- 63
NO- 11
PG- 762-763
IS- 0019-5022
DT- Note

Record - 12

TI- ESSENTIAL OILS - A POTENT SOURCE OF NATURAL PESTICIDES
AU- SINGH. G;UPADHYAY. RK
NA- UNIV GORAKHPUR.DEPT CHEM.GORAKHPUR 273009.INDIA
JN- JOURNAL OF SCIENTIFIC & INDUSTRIAL RESEARCH
PY- 1993
VO- 52
NO- 10
PG- 676-683
IS- 0022-4456
DT- Review
AB- A wide variety of essential oils and their constituents possess varying degrees of pest controlling properties. The plant extracts/essential oils of Mentha piperita. Acorus calamus. Anethum sowa. Piper nigrum. Pongamia glabra and Azadirachta indica have been shown to exhibit grain protectants activity. It is pointed out that the alcoholic and phenolic constituents of essential oils show considerable toxicity to control egg hatching of Aedes aegypti. The oil of Acorus calamus inhibit embryonic development of Dysdercus koenigii at 100 ppm concentration. It is described that the volatile oils of Eucalyptus. Japanese mint. dill. turpentine and citronella show different degrees of attractant and repellent activity against rice weevil (Sitophilus oryzae). pulse beetle (Calloso bruchus chinensis). spice beetle (Stegobium paniceum) and house fly (Musca domestica). The volatile constituents of several essential oils mainly mono- and sesquiterpenoids have been shown to exhibit strong repellent activity against house fly and cockroaches. It is documented that the volatile oils containing aliphatic straight chain ketones and aryl ketonic compounds also exhibit strong repelling tendency against bees. The mono-. sesqui-. di- and triterpenoids isolated from several aromatic plant species have been shown to

possess potential antifeedant activity by contact action. It is described that the nerol, geraniol and citronellol act as Juvenile hormone (JH) analogues. The volatile oil of Lantana camara also exhibit JH like activity on fresh 5th instar nymphs of Dysdercus similies. It is argued that the majority of essential oils and their constituents are potent antifungal and antibacterial agents. Some of the oils such as Citrus sinensis and Hyptis suaveolens are found to be more potent than commercial synthetic fungicides, and exhibit no phytotoxic effect on seedling growth and seed germination of green gram (Vigna radiata). It is described that naturally occurring essential oils and their constituents also exhibit remarkable toxicity against some parasitic worms.
CR- AGARWAL_R. 1979 Vol.17 p.1264. INDIAN J EXP BIOL

Record - 13

TI- EVALUATION OF THE LIVER PROTECTIVE POTENTIAL OF PIPERINE, AN ACTIVE PRINCIPLE OF BLACK AND LONG PEPPERS
AU- KOUL, IB;KAPIL, A
NA- REG RES LAB,DEPT PHARMACOL,CANAL RD,JAMMU 180001,INDIA
JN- PLANTA MEDICA
PY- 1993
VO- 59
NO- 5
PG- 413-417
IS- 0032-0943
AB- Piperine, an active alkaloidal constituent of the extract obtained from Piper longum and Piper nigrum, was evaluated for its antihepatotoxic potential in order to validate its use in traditional therapeutic formulations. This plant principle exerted a significant protection against tert-butyl hydroperoxide and carbon tetrachloride hepatotoxicity by reducing both in vitro and in vivo lipid peroxidation, enzymatic leakage of GPT and AP, and by preventing the depletion of GSH and total thiols in the intoxicated mice. Silymarin, a known hepatoprotective drug was tested simultaneously for comparison. Piperine showed a lower hepatoprotective potency than silymarin.

Record - 14

TI- EVALUATION OF THE MODULATORY INFLUENCE OF BLACK PEPPER (PIPER-NIGRUM, L) ON THE HEPATIC DETOXICATION SYSTEM
AU- SINGH, A;RAO, AR
NA- JAWAHARLAL NEHRU UNIV,SCH LIFE SCI,CANC BIOL LAB,NEW DELHI 110067,INDIA
JN- CANCER LETTERS
PY- 1993
VO- 72
NO- 1-2
PG- 5-9
IS- 0304-3835
AB- The present paper assesses the modifying potential of black pepper on the hepatic biotransformation system in mice. The modulatory effect

was assessed on glutathione S-transferase (GST), cytochrome b5 (cyt. b5), cytochrome P-450 (cyt. P450), acid-soluble sulfhydryl (-SH) content and malondialdehyde (MDA) level. Swiss albino mice of either sex (eight weeks old) were fed on a diet containing 0.5%, 1% and 2% black pepper (w/w) for 10 and 20 days. The findings revealed a significant and dose-dependent increase in GST and -SH content in the experimental groups except the one maintained on 0.5% black pepper diet for 10 days. Elevated levels of cyt. b5 and cyt. P450 were also statistically significant and dose-dependent. The level of MDA was lowered in the group fed on 2% black pepper diet for 20 days. Being a potential inducer of detoxication system, the possible chemopreventive role of black pepper in chemical carcinogenesis is suggested.

Record - 15

TI- COMMON INDIAN SPICES - NUTRIENT COMPOSITION, CONSUMPTION AND CONTRIBUTION TO DIETARY VALUE
AU- PRADEEP, KU;GEERVANI, P;EGGUM, BO
NA- AP AGR UNIV,POSTGRAD & RES CTR HOME SCI,DEPT FOODS & NUTR,HYDERABAD 500030,INDIA
JN- PLANT FOODS FOR HUMAN NUTRITION
PY- 1993
VO- 44
NO- 2
PG- 137-148
IS- 0377-3205
AB- Nutrient composition of eight commonly consumed spices of South India was analysed. Spices analysed were red chillies (Capsicum annum), black pepper (Piper nigrum), coriander seeds (Coriandrum sativum), cumin seeds (Cuminum cyminum), garlic (Allium sativum), asafoetida (Ferula foetida), dry ginger (Zingiber officinale) and ajowan (Carum copticum). The nutrients analysed were proximate principles, minerals, starch, sugars, dietary fibre components, tannins, phytic acid, enzyme inhibitors and amino acids. Dry ginger, ajowan and asafoetida had high calcium (1.0-1.5%) and iron (54-62 mg/100 g) levels. The tannin content of spices was also high (0.9-1.3% DM). Dietary fibre ranged from 14-53%. Spices had appreciable amounts of essential amino acids like lysine and threonine. A survey revealed the average per capita consumption of spices to be 9.54 g and at that level, the nutrient contribution from spices ranged from 1.2 to 7.9% of an average adult Indian male's requirement for different nutrients.

Record - 16

TI- THE USE OF ANTIBIOTICS TO CONTROL SYSTEMIC BACTERIA IN INVITRO CULTURES OF PIPER-NIGRUM CV KUCHING
AU- MEYER, HJ;VANSTADEN, J;ALLEN, S
NA- UNIV NATAL,DEPT BOT,UN FRD RES UNIT PLANT GROWTH & DEV,PIETERMARITZBURG 3200,SOUTH AFRICA
JN- SOUTH AFRICAN JOURNAL OF BOTANY-SUID-AFRIKAANSE TYDSKRIF VIR PLANTKUNDE
PY- 1992

VO- 58
NO- 6
PG- 500-504
IS- 0254-6299
AB- Systemic bacteria in Piper nigrum cv Kuching were controlled in vitro by incubating nodal explants for 7 days on a modified MS medium supplemented with 250 mg l-1 gentamycin. Thereafter the explants were cultured for 7 days on basal medium without antibiotics. This was followed by culturing the explants for 7 days on basal medium with 160 mg l-1 ampicillin, whereafter they were again transferred onto basal medium. The recovery rate of uncontaminated cultures was about 50%. Ninety percent of these plants remained uncontaminated following subsequent subculture. Most of the 14 antibiotics tested did not affect the survival of the explants. Necrotic areas formed on the leaves of the explants with all the antibiotics used if cultured in their presence for more than 14 days. Shoot development and the formation of callus were inhibited by most of the 14 antibiotics tested. The penicillins were less active against the bacteria than the aminoglycosides.

Record - 17
□

TI- MICROPROPAGATION OF BLACK PEPPER (PIPER-NIGRUM LINN) THROUGH SHOOT TIP CULTURES
AU- PHILIP. VJ;JOSEPH. D;TRIGGS. GS;DICKINSON. NM
NA- UNIV CALICUT,DEPT BOT,CALICUT 673635,KERALA,INDIA
LIVERPOOL JOHN MOORES UNIV,SCH BIOL & EARTH SCI,LIVERPOOL L3 3AF,ENGLAND
JN- PLANT CELL REPORTS
PY- 1992
VO- 12
NO- 1
PG- 41-44
IS- 0721-7714
AB- The morphogenetic potential of shoot tip explants of black pepper (Piper nigrum) was investigated and an effective multiple-shoot propagation method is described. Various combinations of media, growth regulators and sterilization treatments were compared. Problems with establishment in tissue culture sometimes occurred, probably caused by endogenous pathogens associated with tissue exudates. The best establishment and proliferation of shoot tip explants was obtained on MS medium containing 1.5 mg l-1 BAP alone; subsequent growth and development of lateral branches was best on media containing 1.5 mg l-1 BAP plus 3.0 mg l-1 IBA. Adenine sulphate inhibited the number of explants showing regeneration but increased the number of shoot buds per regenerating explant. Shoots were rooted on a 50 % strength medium containing 1mg l-1 NAA.

Record - 18

TI- STUDIES ON COLOR RETENTION IN PEPPER SUBJECTED TO DIFFERENT TREATMENTS
AU- GOPALAKRISHNAN. N;THOMAS. PP
NA- REG RES LAB.TRIVANDRUM 695019.INDIA
JN- JOURNAL OF FOOD SCIENCE AND TECHNOLOGY-MYSORE
PY- 1992
VO- 29
NO- 4
PG- 256-257
IS- 0022-1155
DT- Note
AB- Fresh pepper (Piper nigrum L.) was subjected to treatments such as microwave exposure, microwave exposed boiling water blanching and direct boiling water blanching to study the extent of green colour retention. The variation in the chlorophyll content at different stages was insignificant among the samples subjected to the same treatment. The best colour retention was observed in the microwave exposed boiling water blanched samples.

Record - 19

TI- RECORD OF PTEROLOPHIA-GRISEOVARIA BREUNING AS A PEST ON PEPPER (PIPER-NIGRUM L)
AU- RANJITH. AM;PILLAY. VS;SASIKUMARAN. S;MAMMOOTTY. KP
NA- PEPPER RES STN.PANNIYUR.PB 113.TALIPARAMBA 670141.KERALA.INDIA
JN- ENTOMON
PY- 1991
VO- 16
NO- 4
PG- 323-325
IS- 0377-9335
DT- Note
AB- Pterolophia griseovaria Breuning (Cerambycidae) infestation on black pepper is being recorded for the first time in India.

Record - 20

TI- THE FLAVOR-COMPOSITION OF SUPERCRITICAL GAS EXTRACTS .1. PEPPER (PIPER-NIGRUM. VAR MUNTOK)
LA- German
AU- KOLLMANNSBERGER. H;NITZ. S;DRAWERT. F
NA- TECH UNIV MUNICH.INST LEBENSMITTELTECHNOL & ANALYT CHEM.W-8050 FREISING.GERMANY
JN- ZEITSCHRIFT FUR LEBENSMITTEL-UNTERSUCHUNG UND-FORSCHUNG
PY- 1992
VO- 194
NO- 6
PG- 545-551

IS- 0044-3026
DT- Review
AB- In order to analyse the distinct sensorial difference between the preferred supercritical gas extract and comparable distillates of Muntokpepper, the sensory contribution of about 180 identified volatile compounds was evaluated. Limonene, myrcene, linalool, 1,8-cineol, terpinen-5-ol, p- and m-cresol, 3,4-methylenedioxycinnamic aldehyde and piperonal certainly contribute to the total flavour, but a typical pepperodour can be attributed only to oxygen-containing sesquiterpenoids, amounting to 2.8% of the total oil in the supercritical gas extract and less than 0.6% in the distillates. The non-volatile acid amides may contribute to the peppery taste of the supercritical gas extract.

Record - 21

TI- LIGHT SATURATION STUDIES IN BLACK PEPPER (PIPER-NIGRUM L) VARIETIES
AU- MATHAI, CK;SASTRY, KSK
NA- INDIAN INST HORT RES,TREE PHYSIOL LAB,HESSARAGHATTA LAKE POST,BANGALORE 560089,INDIA
JN- COMPARATIVE PHYSIOLOGY AND ECOLOGY
PY- 1991
VO- 16
NO- 4
PG- 129-133
IS- 0379-0436
AB- The traditionally shade grown varieties of pepper(five varieties) presently grown under partial light stress conditions on live standards have shown that they have capacities to light saturate between 138 to 2049-mu-E m-2s-1 of light intensities. A steady photosynthesising pattern of the leaves in a stand upto 2049-mu-E m-2s-1 or more light intensity throughout the day and round the year is a desirable character for better productivity. Cv. Panniyoor 1 was however found to possess the capacity to be steady between 138 to 2049-mu-E m-2s-1. This is a desirable character since pepper is mainly grown in traditional way on live standards with the above range of sunlight energy.

Record - 22

TI- CARCINOGENICITY TESTING OF SOME CONSTITUENTS OF BLACK PEPPER (PIPER-NIGRUM)
AU- WRBA, H;ELMOFTY, MM;SCHWAIREB, MH;DUTTER, A
NA- UNIV VIENNA,INST ANGEW & EXPTL ONKOL,BORSCHKEGASSE 8A,A-1090 VIENNA,AUSTRIA
UNIV ALEXANDRIA,FAC SCI,DEPT ZOOL,ALEXANDRIA,EGYPT
JN- EXPERIMENTAL AND TOXICOLOGIC PATHOLOGY
PY- 1992

VO- 44
NO- 2
PG- 61-65
IS- 0940-2993
AB- In mice, injection of safrole, tannic acid or methylcholanthrene (MCA) during the preweaning period induced tumors in different organs. Safrole and tannic acid (constituents of black pepper) were weak carcinogens when compared with MCA which was used as a carcinogenic control substance. Force feeding of d-limonene (one of the pepper terpenoids) for a long time to the mice which were injected with any of the above 3 substances reduced their carcinogenic activity, while force feeding of piperine (one of black pepper alkaloids) was ineffective.

Record - 23

TI- QUALITY OF POWDERED BLACK PEPPER (PIPER-NIGRUM L) DURING STORAGE .2. PRINCIPAL COMPONENTS ANALYSES OF GC AND SENSORY PROFILES
AU- ' ARASIMHAN. S;RAJALAKSHMI. D;CHAND. N
NA- CENT FOOD TECHNOL RES INST,AREA SENSORY ANAL & CONSUMER ACCEPTANCE,MYSORE 570013,INDIA
JN- JOURNAL OF FOOD QUALITY
PY- 1992
VO- 15
NO- 1
PG- 67-83
IS- 0146-9428
AB- Gas chromatographic finger printing of stored black pepper powder after extraction, volatiles from the Likens-Nickerson extraction and aroma impact fractions were carried out using packed column routinely used in the spice growing countries. Sensory quality, volatile oil and moisture content were also analyzed to trace the changes occurring during storage. The data generated were subjected to principal components analyses to reduce dimensionality and arrive at impact attributes. The oxygenated compounds fraction resolved into 25 to 30 peaks from which a group of 6, including small yet important peaks, was selected. These peaks reflected quality as monitored by sensory response, accounting for 93.4% of information, and are more meaningful than terpene hydrocarbon peaks of high resolution. The probable compounds constituting these principal components are discussed.

Record - 24

TI- PIPERINE-MEDIATED CHANGES IN THE PERMEABILITY OF RAT INTESTINAL EPITHELIAL-CELLS - THE STATUS OF GAMMA-GLUTAMYL TRANSPEPTIDASE ACTIVITY, UPTAKE OF AMINO-ACIDS AND LIPID-PEROXIDATION
AU- JOHRI. RK;THUSU. N;KHAJURIA. A;ZUTSHI. U
NA- CSIR,REG RES LAB,CANAL RD,JAMMU 180001,INDIA

JN- BIOCHEMICAL PHARMACOLOGY
PY- 1992
VO- 43
NO- 7
PG- 1401-1407
IS- 0006-2952
AB- The effect of piperine (1-[5-(1,3-benzodioxol-5-yl)-1-oxo-2,4-pentadienyl]piperidine), (from Piper nigrum) on the absorptive function of the intestine was studied. In vitro experiments showed that piperine (25-100-mu-M) significantly stimulated gamma-glutamyl transpeptidase (gamma-GT, EC 2.3.2.2.) activity, enhanced the uptake of radiolabelled L-leucine, L-isoleucine and L-valine, and increased lipid peroxidation in freshly isolated epithelial cells of rat jejunum. The kinetic behaviour of gamma-GT towards substrate and acceptor altered in the presence of piperine. In the presence of benzyl alcohol, an enhanced gamma-GT activity due to piperine was maintained. These results suggested that piperine may interact with the lipid environment to produce effects which lead to increased permeability of the intestinal cells.

Record - 25

TI- HYDROSTATIC HIGH-PRESSURE TO STERILIZE FOOD .1. APPLICATION TO PEPPER (PIPER-NIGRUM L)
LA- German
AU- KOWALSKI, E;LUDWIG, H;TAUSCHER, B
NA- UNIV HEIDELBERG,INST PHARMAZEUT TECHNOL & BIOPHARM,NEUENHEIMER FELD 346,W-6900 HEIDELBERG,GERMANY
BUNDESFORSCH ANST/_T ERNAHRUNG,INST CHEM & BIOL,W-7500 KARLSRUHE,GERMANY
JN- DEUTSCHE LEBENSMITTEL-RUNDSCHAU
PY- 1992
VO- 88
NO- 3
PG- 74-76
IS- 0012-0413
AB- Black pepper, at 40-degrees-C, was exposed to hydrostatic pressure up to 4000 bar. This led to a decrease by several orders of magnitude in the number of viable microorganisms on both natural pepper and pepper which had been contaminated by defined doses of B. cereus spores. Kinetic studies have shown that the course of inactivation can be described by a reaction order between 1,5 and 2. A reduction of counts was achieved only in the presence of an aqueous medium, however; in dry pepper, the treatment failed. After exposure to pressure, there was a minor change in the relative proportions of the various volatile oils and in those compounds responsible for the pungent taste of the pepper.

Record - 26

TI- NEW RECORD OF WHITEFLY (BEMISIA-TABACI) ON BLACK PEPPER (PIPER-NIGRUM)
AU- RANJITH. AM;PILLAY. VS;SASIKUMARAN. S;MAMMOOTY. KP
NA- KERALA AGR UNIV,PEPPER RES STN,PANNIYUR,TALIPARAMBA 670141,INDIA
JN- INDIAN JOURNAL OF AGRICULTURAL SCIENCES
PY- 1992
VO- 62
NO- 2
PG- 166-168
IS- 0019-5022
DT- Note

Record - 27

TI- CARCINOGENIC EFFECT OF FORCE-FEEDING AN EXTRACT OF BLACK PEPPER (PIPER-NIGRUM) IN EGYPTIAN TOADS (BUFO-REGULARIS)
AU- ELMOFTY. MM;KHUDOLEY. VV;SHWAIREB. MH
NA- UNIV ALEXANDRIA,FAC SCI,DEPT ZOOL,ALEXANDRIA,EGYPT
NN PETROV ONCOL RES INST,LENINGRAD 188646,USSR
UNIV ALEXANDRIA,FAC EDUC,DEPT BIOL,ALEXANDRIA,EGYPT
JN- ONCOLOGY
PY- 1991
VO- 48
NO- 4
PG- 347-350
AB- 50 male and 50 female Bufo regularis were treated, by force-feeding, with an extract of black pepper, at a dose level of 2 mg, 3 times a week for 5 months. The first tumors appeared after 2 months. Liver tumors (hepatocellular carcinomas, lymphosarcomas and fibrosarcomas) were found in 12 males and 18 females. Metastatic deposits of hepatocellular carcinomas were registered in the spleen, kidney, fat body and ovary.

Record - 28

TI- INFLUENCE OF SPICES ON UTILIZATION OF SORGHUM AND CHICKPEA PROTEIN
AU- PRADEEP. KU;GEERVANI. P;EGGUM. BO
NA- ANDHRA PRADESH AGR UNIV,FAC HOME SCI,POST GRAD & RES CTR,HYDERABAD 500030,ANDHRA PRADESH,INDIA
JN- PLANT FOODS FOR HUMAN NUTRITION
PY- 1991
VO- 41
NO- 3
PG- 269-276
AB- Influence of eight common Indian spices on the protein quality of sorghum and chickpea was studied. Spices used include red chillies

(Capsicum annum), black pepper (piper nigrum), coriander seeds (Coriandrum sativum) cumin seeds (Cuminum cyminum), garlic (Allium sativum), asafoetida (Ferula foetida), dry ginger (Zingiber officinale) and ajowan (Carum copticum). Addition of spices did not affect protein digestibility (TD) of sorghum. The BV of all sorghum diets with spices was higher than that of control diet. However, it was significant only in case of diets combined with red chilli + coriander (1:1) mix, black pepper + cumin (1:1) mix, coriander and cumin. Addition of spices did not have any effect on TD or BV of chickpea diets.

Record - 29

TI- EFFECT OF GAMMA PROCESSING ON PREPACKAGED BLACK-AND-WHITE PEPPER (PIPER-NIGRUM L)
AU- SHIGEMURA. R;GERDES. DL;HALL. WR
NA- CHAPMAN COLL,DEPT FOOD SCI & NUTR,ORANGE,CA,92666
CASE SWAYNE INC,SANTA ANA,CA,92701
RADIAT STERILIZERS INC,TUSTIN,CA,92680
JN- FOOD SCIENCE AND TECHNOLOGY-LEBENSMITTEL-WISSENSCHAFT & TECHNOLOGIE
PY- 1991
VO- 24
NO- 2
PG- 135-138
Record - 30

TI- ON THE CAROTENOIDS OF RIPENED PEPPER BERRIES (PIPER-NIGRUM L)
AU- VARIYAR. PS;BANDYOPADHYAY. C
NA- BHABHA ATOM RES CTR,DIV FOOD TECHNOL & ENZYME ENGN,BOMBAY 400085,INDIA
JN- JOURNAL OF FOOD SCIENCE AND TECHNOLOGY-MYSORE
PY- 1990
VO- 27
NO- 5
PG- 294-295
DT- Note
AB- Three carotenoid pigments namely beta-carotene, lycopene and leutin were tentatively identified in the pericarp of ripened berries of pepper (Piper nigrum L.) for the first time using TLC and spectrophotometric methods.

Record - 31

TI- ATTRACTION ACTIVITIES OF SPICES FOR ORIENTAL WEATHERFISH AND YELLOWTAIL
AU- HARADA. K
NA- SHIMONOSEKI UNIV FISHERIES,DEPT FOOD SCI & TECHNOL,SHIMONOSEKI 75965,JAPAN
JN- NIPPON SUISAN GAKKAISHI-BULLETIN OF THE JAPANESE SOCIETY OF

SCIENTIFIC FISHERIES
PY- 1990
VO- 56
NO- 12
PG- 2029-2033
AB- The feeding attraction activities of the water-extracts of spiecs in adult oriental weatherfish Misgurnus anguillicaudatus and juvenile yellowtail Seriola quinqueradiata were statistically estimated on the basis of the time-course obtained from the fish behavior. Among thirty specimens tested in twenty-eight species of spices, allspice Pimenta officinalis and ten others for oriental weatherfish, and allspice and fourteen others for yellowtail were effective in the attraction behavior. Above sixty per cent of the attractive specimens for both fishes were the odorus spice in characteristic. Furthermore the common attractive spices for both the fishes were the seven species of, allspice, caraway Carum carvi and cardamon Elettaria cardamomum in the odorous spice, only white pepper Piper nigrum in the acrid, and garlic Allium sativum, onion Allium cepa and savory Satureia hortensis in the odor-corrective. Especially strong attractants were caraway for oriental weatherfish, and cumin Cuminum cyminum for yellowtail. The attraction activities of caraway, cumin, and allspice clearly depended on the concentration used.

Record - 32

TI- CARCINOGENESIS INDUCED BY BLACK PEPPER (PIPER-NIGRUM) AND MODULATED BY VITAMIN-A
AU- SHWAIREB, MH;WRBA, H;ELMOFTY, MM;DUTTER, A
NA- UNIV VIENNA,INST APPL & EXPTL ONCOL,BORSCHKEGASSE 8A,A-1090 VIENNA,AUSTRIA
UNIV ALEXANDRIA,FAC SCI,DEPT ZOOL,ALEXANDRIA,EGYPT
JN- EXPERIMENTAL PATHOLOGY
PY- 1990
VO- 40
NO- 4
PG- 233-238
AB- Painting and feeding of mice with 2mg of an extract from black pepper on 3 days a week for 3 months results in a significant increase of the number of tumor-bearing mice. Tumor incidence is reduced in those groups of experimental animals receiving 5 or 10mg Vitamin A-palmitate twice weekly for 3 months by feeding or painting during and subsequent to application of pepper extract. Feeding of mice with powder of black pepper in diet (50g/3kg food) has no impact on carcinogenesis.

Record - 33

TI- CHEMICAL AND SENSORY PROPERTIES OF BLACK PEPPER OIL (PIPER-NIGRUM L)
AU- PINO, J;RODRIGUEZ,FEO, G;BORGES, P;ROSADO, A
NA- FOOD IND RES INST,AVE RANCHO BOYEROS KM 3 1-2,HAVANA,CUBA

NATL CTR SCI RES.HAVANA.CUBA
JN- NAHRUNG-FOOD
PY- 1990
VO- 34
NO- 6
PG- 555-560

Record - 34

TI- PHENOLICS OF GREEN PEPPER BERRIES (PIPER-NIGRUM L)
AU- BANDYOPADHYAY. C;NARAYAN. VS;VARIYAR. PS
NA- BHABHA ATOM RES CTR.DIV FOOD TECHNOL & ENZYME ENGN.BOMBAY 400085.INDIA
JN- JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY
PY- 1990
VO- 38
NO- 8
PG- 1696-1699

Record - 35

TI- THE BIOSYNTHESIS OF PIPERINE IN PIPER-NIGRUM
AU- GEISLER. JG;GROSS. GG
NA- UNIV ULM.ALLGEMEINE BOT ABT.ALBERT EINSTEIN ALLEE 11.D-7900 ULM.FED REP GER
UNIV ULM.ALLGEMEINE BOT ABT.ALBERT EINSTEIN ALLEE 11.D-7900 ULM.FED REP GER
JN- PHYTOCHEMISTRY
PY- 1990
VO- 29
NO- 2
PG- 489-492

Record - 36

TI- INCIDENCE OF FOOT-ROT DISEASE OF BLACK PEPPER (PIPER-NIGRUM) IN KERALA IN RELATION TO CULTIVATION PRACTICES
AU- ANANDARAJ. M;ABRAHAM. J;SARMA. YR;BALAKRISHNAN. R
NA- NATL RES CTR SPICES.CALICUT 673012.KERALA.INDIA
JN- INDIAN JOURNAL OF AGRICULTURAL SCIENCES
PY- 1989
VO- 59
NO- 11
PG- 751-753
DT- Note

Record - 37

TI- EFFECT OF BIO-FERTILIZERS ON GROWTH OF BLACK PEPPER (PIPER-NIGRUM)
AU- BOPAIAH. BM;KHADER. KBA

NA- CENT PLANTAT CROPS RES INST.MICROBIOL.KASARAGOD 670124.KERALA.INDIA
JN- INDIAN JOURNAL OF AGRICULTURAL SCIENCES
PY- 1989
VO- 59
NO- 10
PG- 682-683
DT- Note

Record - 38

TI- RELATIONSHIPS OF FOLIAR NUTRIENT LEVELS WITH YIELD IN BLACK PEPPER (PIPER-NIGRUM L)
AU- NYBE. EV:NAIR. PCS:WAHID. PA
NA- KERALA AGR UNIV.COLL HORT.VALLANIRRARA 680654.KERALA.INDIA
JN- TROPICAL AGRICULTURE
PY- 1989
VO- 66
NO- 4
PG- 345-349

Record - 39

TI- DRYING STUDIES ON BLACK PEPPER (PIPER-NIGRUM L)
AU- PATIL. RT
NA- CENT INST AGR ENGN.NABI BAGH BERASIA RD.BHOPAL 462018.INDIA
JN- JOURNAL OF FOOD SCIENCE AND TECHNOLOGY-MYSORE
PY- 1989
VO- 26
NO- 4
PG- 230-231
DT- Note

Record - 40

TI- STUDIES ON THE PHYSICOCHEMICAL CHARACTERISTICS OF VOLATILE OIL FROM PEPPER (PIPER-NIGRUM) EXTRACTED BY SUPERCRITICAL CARBON-DIOXIDE
AU- SANKAR. KU
NA- CENT FOOD TECHNOL RES INST.MYSORE 570013.KARNATAKA.INDIA
JN- JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE
PY- 1989
VO- 48
NO- 4
PG- 483-493
PA- 2127611 GE:VITZTHUM_O

Record - 41

TI- PRODUCTIVITY OF BLACK PEPPER VINES (PIPER-NIGRUM L) AS INFLUENCED BY THE LIGHT AVAILABILITY DURING PRE FLOWERING STAGE
AU- MATHAI. CK;SASTRY. KSK
NA- INDIAN INST HORT RES.TREE PHYSIOL LABS.HESSERGHATTA LAKE POST.BANGALORE 560089.INDIA
JN- COMPARATIVE PHYSIOLOGY AND ECOLOGY
PY- 1988
VO- 13
NO- 3
PG- 97-102

Record - 42

TI- LIGNANS FROM LEAVES OF PIPER-NIGRUM LINN
AU- SUMATHYKUTTY. MA;RAO. JM
NA- REG RES LAB.TRIVANDRUM 695019.INDIA
JN- INDIAN JOURNAL OF CHEMISTRY SECTION B-ORGANIC CHEMISTRY INCLUDING MEDICINAL CHEMISTRY
PY- 1988
VO- 27
NO- 4
PG- 388-389
DT- Note

Record - 43

TI- CARCINOGENICITY TESTING OF BLACK PEPPER (PIPER NIGRUM) USING THE EGYPTIAN TOAD (BUFO-REGULARIS) AS A QUICK BIOLOGICAL TEST ANIMAL
AU- ELMOFTY. MM;SOLIMAN. AA;ABDELGAWAD. AF;SAKR. SA;SHWAIREB. MH
NA- UNIV ALEXANDRIA.FAC SCI.DEPT ZOOL.ALEXANDRIA.EGYPT
UNIV ALEXANDRIA.FAC MED.DEPT PATHOL.ALEXANDRIA.EGYPT
MONOUFIA UNIV.FAC SCI.DEPT ZOOL.SHEBIN EL KOM.EGYPT
JN- ONCOLOGY
PY- 1988
VO- 45
NO- 3
PG- 247-252

Record - 44

TI- DISTRIBUTION OF PIPERINE IN VEGETATIVE PARTS OF PIPER-NIGRUM
AU- SEMLER. U;GROSS. GG
NA- UNIV ULM.ALLGEMEINE BOT ABT.OBERER ESELSBERG.D-7900 ULM.FED REP GER
JN- PHYTOCHEMISTRY
PY- 1988
VO- 27
NO- 5
PG- 1566-1567
DT- Note

Record - 45

TI- RECORD OF SAHYADRASSUS-MALABARICUS (MOORE) DAMAGING GLIRICIDIA-MACULATA. A STANDARD OF BLACK PEPPER PIPER-NIGRUM IN KERALA
AU- DEVASAHAYAM. S;PREMKUMAR. T;KOYA. KMA
NA- CENT PLANTAT CROPS RES INST.REG STN.MARIKUNNU PO.CALICUT 673012.INDIA
JN- ENTOMON
PY- 1987
VO- 12
NO- 4
PG- 391-392
DT- Note

Record - 46

TI- LIQUID-CHROMATOGRAPHIC METHOD FOR DETERMINATION OF PIPERINE IN PIPER-NIGRUM (BLACK AND WHITE PEPPER)
AU- WEAVER. KM;NEALE. ME;LANEVILLE. A
NA- STANGE CANADA INC.MISSISSAUGA L4V 1C7.ONTARIO.CANADA
RYERSON POLYTECH INST.TORONTO M5B 2K3.ONTARIO.CANADA
JN- JOURNAL OF THE ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS
PY- 1988
VO- 71
NO- 1
PG- 53-55
DT- Note

Record - 47

TI- NEW RECORD OF 2 FLEA BEETLES INFESTING BLACK PEPPER PIPER-NIGRUM L LEAVES
AU- KUMAR. TP;NAIR. MRGK
NA- CENT PLANTAT CROPS RES INST.REG STN.CALICUT 673012.INDIA
JN- CURRENT SCIENCE
PY- 1987
VO- 56

NO- 6
PG- 271-271
DT- Note
CR- KUMAR_TP. 1981 p.168. THESIS KERALA AGR U
PILLAI_GB. 1978 p.15. P NATIONAL SEMINAR P

Record - 48

TI- EFFECT OF DIFFERENT INSECTICIDES ON THE CONTROL OF POLLU BEETLE LONGITARSUS-NIGRIPENNIS MOTS. A MAJOR PEST OF BLACK PEPPER PIPER-NIGRUM L
AU- KUMAR. TP;BANERJEE. SK;DEVASAHAYAM. S;KOYA. KMA
NA- CENT PLANTAT CROPS RES INST.REG STN.CALICUT 673012.INDIA
JN- ENTOMON
PY- 1986
VO- 11
NO- 4
PG- 219-221

□

Record - 49
□

TI- CURRENT STATE AND PROSPECTIVE TRENDS OF BLACK PEPPER (PIPER-NIGRUM L) PRODUCTION
AU- DEWAARD. PWF
NA- KONINKLIJK INST TROP.MAURITSKADE 63.1092 AD AMSTERDAM.NETHERLANDS
JN- OUTLOOK ON AGRICULTURE
PY- 1986
VO- 15
NO- 4
PG- 186-195

Record - 50
□

TI- HISTOLOGY OF LEAF AND OF LEAF INFECTION OF PIPER-NIGRUM (BLACK PEPPER) BY PHYTOPHTHORA-PALMIVORA
LA- German
AU- FEUERSTEIN. P;HOHL. HR
NA- UNIV ZURICH.INST PFLANZENBIOL.ZOLLIKERSTR 107.CH-8008 ZURICH.SWITZERLAND
JN- BOTANICA HELVETICA
PY- 1986
VO- 96
NO- 1
PG- 95-108

Record - 51

TI- BLACK PEPPER. PIPER-NIGRUM L
AU- GOVINDARAJAN. VS;NARASIMHAN. S
NA- CENT FOOD TECHNOL RES INST.MYSORE 570013.KARNATAKA.INDIA

JN- ABSTRACTS OF PAPERS OF THE AMERICAN CHEMICAL SOCIETY
PY- 1986
VO- 191
NO- APR
PG- 38-AGFD
DT- Meeting Abstract

Record - 52

TI- UTILIZATION OF THE DIAZOTROPH. AZOSPIRILLUM FOR INDUCING ROOTING IN PEPPER CUTTINGS (PIPER-NIGRUM L)
AU- GOVINDAN. M;CHANDY. KC
NA- REG AGR RES STN.PILICODE 670353.INDIA
JN- CURRENT SCIENCE
PY- 1985
VO- 54
NO- 22
PG- 1186-1188
DT- Note

Record - 53

TI- COMPOSITIONAL DIFFERENCES OF BLACK. GREEN AND WHITE PEPPER (PIPER-NIGRUM L) OIL FROM 3 CULTIVARS
AU- BUCKLE. KA;RATHNAWATHIE. M;BROPHY. JJ
NA- UNIV NEW S WALES.SCH FOOD SCI & TECHNOL.POB 1.KENSINGTON.NSW 2033.AUSTRALIA
UNIV NEW S WALES.SCH CHEM.KENSINGTON.NSW 2033.AUSTRALIA
JN- JOURNAL OF FOOD TECHNOLOGY
PY- 1985
VO- 20
NO- 5
PG- 599-613

Record - 54

TI- 1ST REPORT OF CYLAS-FORMICARIUS F ON BLACK PEPPER. PIPER-NIGRUM L
AU- RANJITH. AM
NA- REG AGR RES STN.PILICODE 670353.INDIA
JN- CURRENT SCIENCE
PY- 1985
VO- 54
NO- 16
PG- 810-810
DT- Note

Record - 55

TI- DECONTAMINATION OF SPICES BY ETHYLENE-OXIDE - THE CASE OF CLOVE (EUGENIA-CARYOPHYLLUS SPRENG) AND OF WHITE PEPPER (PIPER-NIGRUM L)
LA- French
AU- MURAZ. B;CHAIGNEAU. M
NA- UNIV PARIS 05.LAB GAZ.4 AVE OBSERV.F-75270 PARIS 06.FRANCE
JN- ANNALES PHARMACEUTIQUES FRANCAISES
PY- 1985
VO- 43
NO- 1
PG- 15-21

Record - 56

TI- PREVENTION OF PHOTOINDUCED CHLOROPHYLL LOSS BY THE USE OF LIME REFLECTANT ON THE LEAVES OF BLACK PEPPER (PIPER-NIGRUM L)
AU- VIJAYAKUMAR. KR;UNNI. PN;VAMADEVAN. VK
NA- CTR WATER RESOURCES DEV & MANAGEMENT.DIV WATER MANAGEMENT AGR.CALICUT
673571.KERALA.INDIA
JN- AGRICULTURAL AND FOREST METEOROLOGY
PY- 1985
VO- 34
NO- 1
PG- 17-20

Record - 57

TI- APPLICATION OF A LOW-DOSE OF 2,4-D TO PROMOTE FRUIT-DEVELOPMENT IN PIPER-NIGRUM
AU- HARIHARAN. M;UNNIKRISHNAN. K
NA- UNIV CALICUT.DEPT BOT.CALICUT 673635.KERALA.INDIA
JN- SEED SCIENCE AND TECHNOLOGY
PY- 1985
VO- 13
NO- 1
PG- 257-264

Record - 58

TI- EFFECT OF SOURCE REMOVAL ON DEVELOPING SPIKE IN BLACK PEPPER (PIPER-NIGRUM L)
AU- KUMAR. PH;SREEDHARAN. C
NA- KERALA AGR UNIV.COLL HORT.DEPT AGRON.VELLANIKKARA 680

652.TRICHUR.KERALA.INDIA
JN- TURRIALBA
PY- 1984
VO- 34
NO- 3
PG- 343-345

Record - 59

TI- LITTLE LEAF DISEASE OF PIPER-NIGRUM IN SRI-LANKA
AU- RANDOMBAGE. S;BANDARA. JMRS
NA- UNIV PERADENIYA.FAC AGR.DEPT AGR BIOL.PERADENIYA.SRI LANKA
JN- PLANT PATHOLOGY
PY- 1984
VO- 33
NO- 4
PG- 479-482

Record - 60

TI- CHANGES IN PROTEIN CONTENTS OF PIPER-NIGRUM LINN FRUITS DUE TO FUNGAL INFESTATION
AU- PRASAD. MM;DAS. N
NA- BHAGALPUR UNIV.POSTGRAD DEPT BOT.MED PLANT RES LAB.BHAGALPUR.BIHAR.INDIA
JN- NATIONAL ACADEMY SCIENCE LETTERS-INDIA
PY- 1983
VO- 6
NO- 9
PG- 295-296

Record - 61

TI- EFFECT OF BERRY MATURATION ON SOME CHEMICAL-CONSTITUENTS OF BLACK. GREEN AND WHITE PEPPER (PIPER-NIGRUM L) FROM 3 CULTIVARS
AU- RATHNAWATHIE. M;BUCKLE. KA
NA- UNIV NEW S WALES.SCH FOOD TECHNOL.KENSINGTON.NSW 2033.AUSTRALIA
JN- JOURNAL OF FOOD TECHNOLOGY
PY- 1984
VO- 19
NO- 3
PG- 361-367

Record - 62

TI- INVITRO RESPONSES OF BLACK PEPPER (PIPER-NIGRUM)
AU- MATHEWS. VH;RAO. PS
NA- BHABHA ATOM RES CTR.DIV BIOORGAN.BOMBAY 400085.INDIA
JN- CURRENT SCIENCE

PY- 1984
VO- 53
NO- 4
PG- 183-186

Record - 63

TI- EFFECT OF MATURITY ON SOME CHEMICAL-CONSTITUENTS OF SRI-LANKAN PEPPER (PIPER-NIGRUM L)
AU- JANSZ, ER;BALACHANDRAN, S;PACKIYASOTHY, EV;RATNAYAKE, S
NA- CEYLON INST SCI & IND RES,POB 787,COLOMBO,SRI LANKA
JN- JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE
PY- 1984
VO- 35
NO- 1
PG- 41-46

Record - 64

TI- DETERMINATION OF PIPERINE IN PEPPER (PIPER-NIGRUM) USING HIGH-PERFORMANCE LIQUID-CHROMATOGRAPHY
AU- RATHNAWATHIE, M;BUCKLE, KA
NA- UNIV NEW S WALES,SCH FOOD TECHNOL,KENSINGTON,NSW 2033,AUSTRALIA
JN- JOURNAL OF CHROMATOGRAPHY
PY- 1983
VO- 264
NO- 2
PG- 316-320
DT- Note

Record - 65

TI- STUDIES ON BLACKENING OF PEPPER (PIPER-NIGRUM, LINN) DURING DEHYDRATION
AU- MANGALAKUMARI, CK;SREEDHARAN, VP;MATHEW, AG
NA- CSIR,REG RES LAB,TRIVANDRUM 695019,KERALA,INDIA
JN- JOURNAL OF FOOD SCIENCE
PY- 1983
VO- 48
NO- 2
PG- 604-606

Record - 66

TI- MINERAL-NUTRITION OF SLOW WILT AFFECTED BLACK PEPPER (PIPER-NIGRUM L)
AU- WAHID, PA;KAMALAM, NV;VENUGOPAL, VK
NA- COLL HORT,VELLANIKKARA 680654,KERALA,INDIA
JN- JOURNAL OF PLANTATION CROPS

PY- 1982
VO- 10
NO- 1
PG- 21-25

Record - 67

TI- TROPHOTYLENCHULUS-FLORIDENSIS-RASKI. A NEW ENDO-PARASITE OF PIPER-NIGRUM L FROM KERALA
AU- MOHANDAS. C;RAMANA. KV
NA- CENT PLANTAT CROPS RES INST.REG STN.CALICUT 673012.KERALA.INDIA
JN- JOURNAL OF PLANTATION CROPS
PY- 1982
VO- 10
NO- 1
PG- 53-54
DT- Note

Record - 68

TI- ACCUMULATION PATTERN OF OLEORESIN AND RELATED CHEMICAL-CONSTITUENTS IN BLACK PEPPER (PIPER-NIGRUM) BERRIES DURING GROWTH AND DEVELOPMENT
AU- MATHAI. CK
NA- CENT PLANTAT CROPS RES INST.REG STN.VITTAL 574243.KARNATAKA.INDIA
JN- QUALITAS PLANTARUM-PLANT FOODS FOR HUMAN NUTRITION
PY- 1981
VO- 31
NO- 1
PG- 3-10

Record - 69

TI- CONSTITUENTS OF PEPPER .3. ISOBUTYL AMIDES FROM PEPPER (PIPER-NIGRUM L)
AU- NAKATANI. N;INATANI. R
NA- OSAKA CITY UNIV.FAC SCI LIVING.DEPT FOOD & NUTR.SUMIYOSHI KU.OSAKA 558.JAPAN
JN- AGRICULTURAL AND BIOLOGICAL CHEMISTRY
PY- 1981
VO- 45
NO- 6
PG- 1473-1476

Record - 70

TI- EFFECT OF BLACK PEPPER (PIPER-NIGRUM LINN) AND PIPERINE ON GROWTH. BLOOD-CONSTITUENTS AND ORGAN WEIGHT IN RATS
AU- SRINIVASAN. MR;SATYANARAYANA. MN
NA- CENT FOOD TECHNOL RES INST.DISCIPLINE BIOCHEM & APPL NUTR.MYSORE 570013.INDIA

JN- NUTRITION REPORTS INTERNATIONAL
PY- 1981
VO- 23
NO- 5
PG- 871-876

Record - 71

TI- CONSTITUENTS OF PEPPER .2. STRUCTURE AND SYNTHESIS OF NEW PHENOLIC AMIDES FROM PIPER-NIGRUM L
AU- INATANI, R;NAKATANI, N;FUWA, H
NA- OSAKA CITY UNIV,FAC SCI LIVING,DEPT FOOD & NUTR,SUMIYOSHI KU,OSAKA 558,JAPAN
JN- AGRICULTURAL AND BIOLOGICAL CHEMISTRY
PY- 1981
VO- 45
NO- 3
PG- 667-673

Record - 72

TI- ISOLATION, IDENTIFICATION, AND INSECTICIDAL PROPERTIES OF PIPER-NIGRUM AMIDES
AU- SU, HCF;HORVAT, R
NA- USDA SEA,STORED PROD INSECTS RES & DEV LAB,SAVANNAH,GA,31403 USDA SEA,RICHARD B RUSSELL AGR RES CTR,ATHENS,GA,30604
JN- JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY
PY- 1981
VO- 29
NO- 1
PG- 115-118

Record - 73

TI- CONSTITUENTS OF PEPPER .1. STRUCTURES AND SYNTHESES OF 2 PHENOLIC AMIDES FROM PIPER-NIGRUM L
AU- NAKATANI, N;INATANI, R;FUWA, H
NA- OSAKA CITY UNIV,FAC SCI LIVING,DEPT FOOD & NUTR,SUMIYOSHI KU,OSAKA 558,JAPAN
JN- AGRICULTURAL AND BIOLOGICAL CHEMISTRY
PY- 1980
VO- 44
NO- 12
PG- 2831-2836

Piper longum:

Record - 1

TI- MYCOBIOTA AND MYCOTOXINS IN HERBAL DRUGS OF INDIAN PHARMACEUTICAL INDUSTRIES
AU- CHOURASIA, HK
NA- CENT INST MED & AROMAT PLANTS,DIV PLANT PATHOL,PO CIMAP,LUCKNOW 226015,UTTAR PRADESH,INDIA
BHAGALPUR UNIV,DEPT BOT,MYCOTOXIN RES LAB,BHAGALPUR 812007,INDIA
JN- MYCOLOGICAL RESEARCH
PY- 1995
VO- 99
NO- Pt6
PG- 697-703
IS- 0953-7562
AB- Crude samples of 12 drug plants (constituents of five finished herbal drugs) were examined for their mould profile and the presence of mycotoxins (aflatoxins, ochratoxin A, citrinin and zearalenone). The most frequently isolated fungi were species of Aspergillus and Fusarium. Aspergillus spp. were isolated from 54% of the crude drug samples with the highest incidence (52%) on Piper longum fruits. Isolation frequencies of several fungi were related to weather conditions 2 wk prior to analysis. Of 95 strains of Aspergillus flavus, 11 of A. parasiticus, 75 of A. ochraceus and 63 of Fusarium oxysporum screened for aflatoxins, ochratoxin A and zearalenone production on synthetic media, 42%, 45% 16% and 26% isolates produced respective mycotoxins. Natural mycotoxin contamination was studied both in crude herbal drugs and their finished commercial products, 43% and 64% of which showed the presence of mycotoxins. Afl-B-1 was the most frequent mycotoxin recorded in almost all the samples beyond the tolerance level fixed by the World Health Organization.

Record - 2

TI- MANAGEMENT OF GIARDIASIS BY AN IMMUNO-MODULATORY HERBAL DRUG PIPPALI-RASAYANA
AU- AGARWAL, AK;SINGH, M;GUPTA, N;SAXENA, R;PURI, A;VERMA, AK;SAXENA, RP; DUBEY, CB;SAXENA, KC
NA- CENT DRUG RES INST,DIV BIOCHEM & MICROBIOL,LUCKNOW 226001,UTTAR PRADESH,INDIA
CENT DRUG RES INST,DIV BIOCHEM & MICROBIOL,LUCKNOW 226001,UTTAR PRADESH,INDIA
STATE AYURVED COLL & HOSP,LUCKNOW 226004,UTTAR PRADESH,INDIA
JN- JOURNAL OF ETHNOPHARMACOLOGY
PY- 1994
VO- 44
NO- 3
PG- 143-146
IS- 0378-8741
AB- Pippali rasayana (PR), an Ayurvedic herbal medicine, prepared from Piper longum (Pippali) and Butea monosperma (Palash), and prescribed for the treatment of chronic dysentery and worm infestations was tested for anti-giardial and immune-stimulatory activity in mice.

infected with Giardia lamblia trophozoites. It produced up to 98% recovery from the infection. The rasayana had no killing effect on the parasite in vitro. It induced significant activation of macrophages as evidenced by increased macrophage migration index (MMI) and phagocytic activity. Enhancement of host resistance could be one of the possible mechanisms contributing towards the recovery of animals from the giardial infection.

Record - 3

TI- EVALUATION OF THE LIVER PROTECTIVE POTENTIAL OF PIPERINE, AN ACTIVE PRINCIPLE OF BLACK AND LONG PEPPERS
AU- KOUL, IB;KAPIL, A
NA- REG RES LAB,DEPT PHARMACOL,CANAL RD,JAMMU 180001,INDIA
JN- PLANTA MEDICA
PY- 1993
VO- 59
NO- 5
PG- 413-417
IS- 0032-0943
AB- Piperine, an active alkaloidal constituent of the extract obtained from Piper longum and Piper nigrum, was evaluated for its antihepatotoxic potential in order to validate its use in traditional therapeutic formulations. This plant principle exerted a significant protection against tert-butyl hydroperoxide and carbon tetrachloride hepatotoxicity by reducing both in vitro and in vivo lipid peroxidation, enzymatic leakage of GPT and AP, and by preventing the depletion of GSH and total thiols in the intoxicated mice. Silymarin, a known hepatoprotective drug was tested simultaneously for comparison. Piperine showed a lower hepatoprotective potency than silymarin.

Record - 4

TI- PLANT-REGENERATION FROM CALLUS-CULTURES OF PIPER-LONGUM L BY ORGANOGENESIS
AU- BHAT, SR;KACKAR, A;CHANDEL, KPS
NA- NATL BUR PLANT GENET RESOURCES,NATL PLANT TISSUE CULTURE REPOSITORY,PUSA CAMPUS,NEW DELHI 110012,INDIA
JN- PLANT CELL REPORTS
PY- 1992
VO- 11
NO- 10
PG- 525-528
IS- 0721-7714
AB- Plant regeneration from callus cultures of Piper longum was achieved through organogenesis. In vitro grown shoots were used as explants for callus induction. Competent callus was initiated around the nodal ring of tissue using Murashige and Skoog medium supplemented with 1.0 mg.l-1 L-naphthaleneacetic acid and 0.2 mg.l-1 N6-benzyladenine.

Optimum growth regulator concentrations for shoot induction and shoot elongation were found to be 0.5 mg.l-1 indole-3-acetic acid with 1.5 mg.l-1 benzyladenine, and 0.1 mg.l-1 indole-3-acetic acid with 0.2 mg.l-1 benzyladenine, respectively. Elongated shoots were rooted on half-strength Murashige and Skoog medium having 0.1 mg.l-1 indole-3-acetic acid. The rooted plants were successfully established in soil.

Record - 5

TI- OCCURRENCE OF HELOPELTIS-THEIVORA WATERHOUSE (MIRIDAE, HEMIPTERA) AS A PEST OF INDIAN LONG PEPPER PIPER-LONGUM LINN
AU- ABRAHAM, CC
NA- COLL HORT,TRICHUR 680654,KERALA,INDIA
JN- ENTOMON
PY- 1991
VO- 16
NO- 3
PG- 245-246
IS- 0377-9335
DT- Note
AB- Helopeltis theivora Waterhouse was recorded to cause severe damage to the tender foliage of the Indian long pepper Piper longum. Application of neem kernel suspension at two percent, reduced the extent of damage by 70 percent.

Record - 6

TI- ARISTOLACTAMS AND 4,5-DIOXOAPORPHINES FROM PIPER-LONGUM
AU- DESAI, SJ;PRABHU, BR;MULCHANDANI, NB
NA- BHABHA ATOM RES CTR,DIV BIOORGAN,BOMBAY 400085,INDIA
JN- PHYTOCHEMISTRY
PY- 1988
VO- 27
NO- 5
PG- 1511-1515

Record - 7

TI- DEHYDROPIPERNONALINE, AN AMIDE POSSESSING CORONARY VASODILATING ACTIVITY, ISOLATED FROM PIPER-LONGUM L
AU- SHOJI, N;UMEYAMA, A;SAITO, N;TAKEMOTO, T;KAJIWARA, A;OHIZUMI, Y
NA- TOKUSHIMA BUNRI UNIV,DEPT PHARM,YAMASHIRO CHO,TOKUSHIMA 770,JAPAN
MITSUBISHI KASEI INST LIFE SCI,MACHIDA,TOKYO 194,JAPAN
JN- JOURNAL OF PHARMACEUTICAL SCIENCES
PY- 1986
VO- 75
NO- 12

PG- 1188-1189

Record - 8

TI- PIPER-LONGUM L - A NEW HOST RECORD FOR COLLECTOTRICHUM-GLOEOSPORIOIDES PENZ
AU- SATHYARAJAN. PK;NASEEMA. A
NA- REG AGR RES STN.KASARAGOD 670353.INDIA
JN- CURRENT SCIENCE
PY- 1985
VO- 54
NO- 13
PG- 637-637
DT- Note

Record - 9

TI- STUDIES ON THE CONSTITUENTS OF THE CRUDE DRUG PIPERIS-LONGI FRUCTUS - ON THE ALKALOIDS OF FRUITS OF PIPER-LONGUM L
AU- TABUNENG. W;BANDO. H;AMIYA. T
NA- HOKKAIDO INST PHARMACEUT SCI.7-1 KATSURAOKA CHO.OTARU 047-02.JAPAN
JN- CHEMICAL & PHARMACEUTICAL BULLETIN
PY- 1983
VO- 31
NO- 10
PG- 3562-3565

**** End of Data ****