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Vienna, Austria, 8 - 12 October 1973

PROBLEMS OF ACCEPTABILITY OF THE SCP OBTAINED FROM N-PARAFFINS 1/

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SUMMARY

PROBLEMS OF ACCEPTABILITY OF THE SCP OBTAINED FROM n-PARAFFINS 1/

A. Sanna*

Following A.A. the problem of acceptability of the SCP obtained from n-paraffins, as well as of other non-conventional proteic sources, is to be put this way :

1) Persuasion action (through experimental data) about the complete safety of the substratum utilised and of the final fermentation product.

2) Overcoming the psychological obstacles caused by the incapability to give up the long-living feeding traditions rooted in the man of the street.

In the first case, the problem of acceptability of the SCP can be overcome by a multi-national agreement about the evaluation methods; in the second one, the problem consists in getting over the prejudices which have been so awkwardly raised by the informative press about the quality of the products obtained from animals fed with the new proteic sources.

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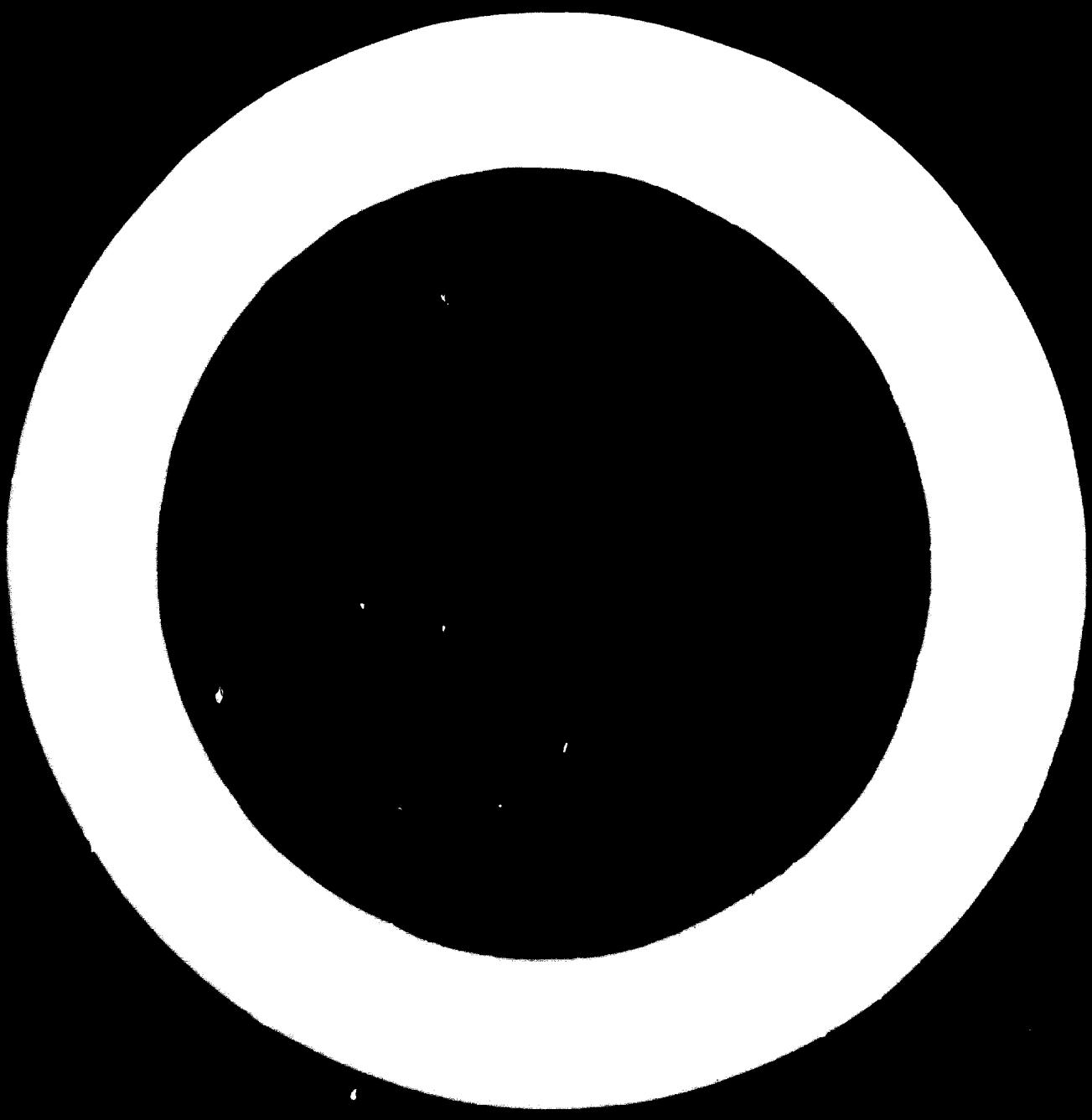
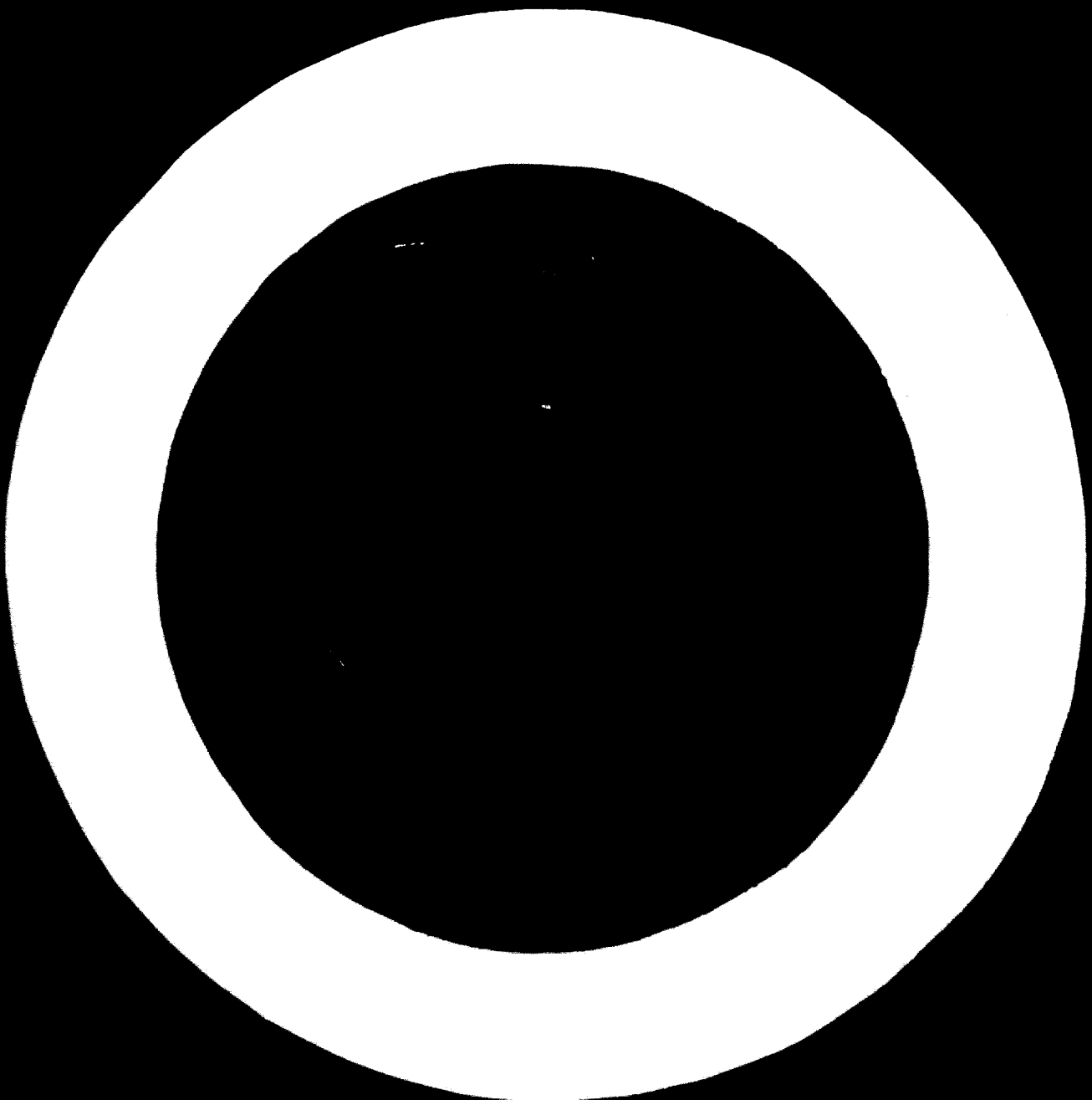




Greater difficulties shall have to be faced in those countries where the religious tradition constitutes a determinant element for the choice of the food.
Said countries, and the developing ones in particular, unfortunately, are those that mostly require a development of zootechny and consequently need alternative efficient solutions for cattle feeding, in that they are already excluded from the international markets of traditional proteic sources.

A first discussion premise may be represented by the legislative measures adopted in certain countries in connection with the rules for the employment of SCP from n-paraffins; however, we still hope that an agreement may be reached on a world-wide scale as regards the evaluation of all the so-called non-conventional proteic sources before the problem of malnutrition, which has already reached dramatic levels in some countries, may become general.

The search for new proteins for animal feeding is a subject the importance of which is becoming more and more alarming as reports from various parts of the world inform us of a dramatic shortage of proteins from conventional sources. Only a few years ago, the idea of exploiting n-paraffin as a source of carbon to gain proteins would have been classified as science fiction. Something like swallowing a super tablet as a substitute to a good meal. To-day, the resort to fermentation to produce feed and perhaps food of high proteic value, employing the so-called "non-conventional" sources of carbon is becoming a necessity.

Within 1974, Liquichimica will have the capacity to produce 100.000 t/y of proteins, grown on a substratus of n-paraffin which may well substitute the proteins so far only obtainable from conventional sources. When compared with the present market requirements this quantity is practically insignificant. It will be however the world's first production on industrial scale.

The problem of undernourishment must be tackled by each developing Country in close connection with the envisaged agricultural reorganisation and development. For instance, countries producers of cotton, peanuts and, as it is the case in Northern Asia, soja, should make the most of the by-products and use them as feeding-stuff of high proteic value. The problem is more complicated when dealing with

Countries h ving vast areas of desertic land, there the agriculture is much poorer than in the tropical countries. Many of them are situated in North Africa and in the Middle East, where, if the agricultural resources are scarce, the crude oil resources are rich. In these Countries, the production of yeasts from n-paraffin would offer great advantages, such as:

- improvement of the quality of the crude oil derivatives through de-paraffinisation, and their consequent price increase.
- the yeasts have a much larger domestic market than other petroleum products which makes it possible for the oil producing countries to achieve what they have always been aiming to, namely the sale in their respective domestic markets of petroleum products with a high added value.
- since the yeasts must be produced on vast scale in order to be economical, the excess of proteins available will be an inducement to foster chicken and pig farming with the result that not only the domestic market would be satisfied but it should be possible to create an important export trade.

PROBLEMS OF ACCEPTABILITY

About ten years ago the Press published for the first time some reports on the possible use of "proteins from hydrocarbon" for human feeding. Some silly definitions such as "petroleum steaks" and "eggs and veal from hydrocarbons" which were spread around without the support of adequate technical/scientific arguments, shocked the public opinion actually shaken by the foregoing news about, food, water and air pollution. Those who had begun to look for new

supplies of proteins and had found in hydrocarbon a possible solution of their problem, found themselves facing a counterpart, the consumer, totally mis-informed and therefore hardly prepared to accept a change which, apart from any other consideration, upset the best and hardly touchable traditions of human nutrition. To talk about "synthetic proteins" or "hydrocarbon proteins" is a biological nonsense because neither derives S.C.P. from an industrial synthesis, nor do steaks and eggs from animals fed with said proteins show any trace of hydrocarbons.

Actually nobody could deny that:

- there are some microorganisms (yeasts, in this case) which grow and multiply themselves on different substrata,
- some of those microorganisms are normally used to obtain products of large human consumption such as beer, wine, bread, antibiotics, vitamins, etc.
- through a biological process, man can use substances which would otherwise be useless (cornflour, pressed grapes, barley, etc.)
- some microorganisms use for their growth (and therefore transform) some substrata which may be defined as "non-conventional" but are nevertheless "natural" such as n-paraffin which is a well defined and very pure fraction of oil.

It is therefore clear that the problems of acceptability may be circumscribed to:

1 - a campaign aiming to convince consumers that the substances used are just as safe as the final product obtained by fermentation;

2 - overcome some of the psycological impediments mainly deriving from the reluctance of the man of the street to abandon some deeply rooted traditions.

Before one starts tackling the two above mentioned problems it is advisable to recollect the nutritional chain to which S.C.P. is subject

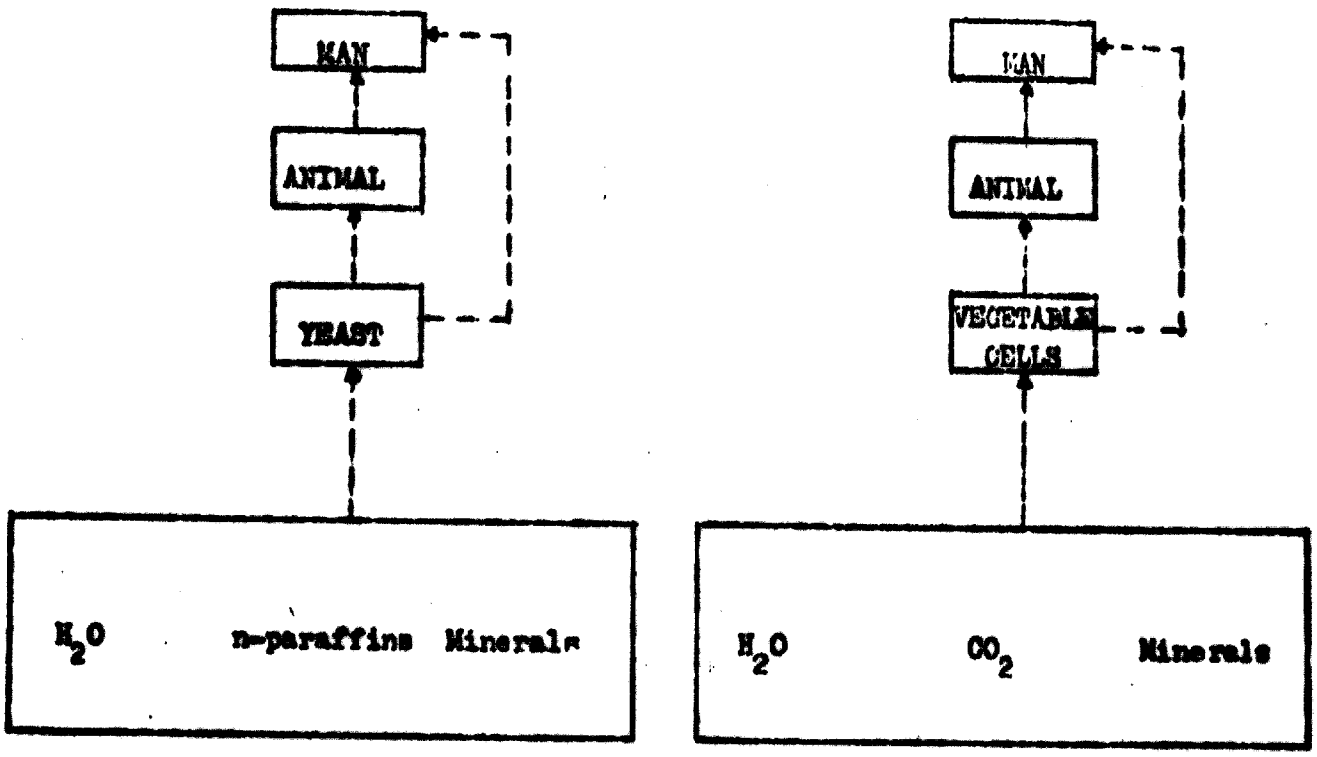


Fig. 1

As one can easily see, the carbon source is the only different component in the biological/nutritional cycle.

There are two natural filters (yeasts and animal) between n-paraffin and man. If, for a moment, one would ignore the danger deriving from the accumulation of toxic substances - this point will be examined later - one can readily see that the nutritional chain relative to proteins from n-paraffin is longer than any other. The use of dejections in animal breed-

ing (cattle and poultry) as feeding stuff is, like urea a very topical subject. In this case the nutritional chain is shorter (one ring less).

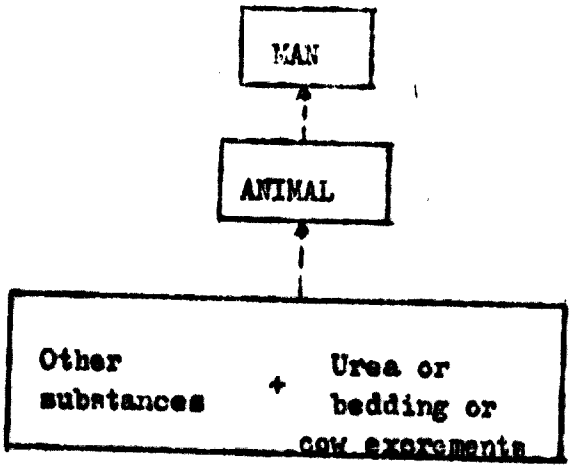


Fig. 2

It seems obvious that the question must be considered from the view point of sanitary safety of the substratus, of the yeasts and of the final product. The eventual accumulation of toxic substances in the single rings is still being ignored. This is also valid if the ring animal is excluded. The possibility of using the "non-conventional" protein sources for human feeding, according to what was said at some recent scientific meetings, does not seem to be any longer remote.

CONSIDERATION ON THE SAFETY OF SUBSTRATUS AND PRODUCT

The problem must be approached from two different angles: according to the counter party. If the counter-party is the man of the street, it may suffice to say that proteins from n-paraffin contain one fifth, one tenth, and one hundredth of the benzopyrene

(the Press has made the man of the street well acquainted with the noxious effects of benzopyrene) contained in the dishes which we are daily eating without the slightest hesitation. We may also say that man has been swallowing yeats from the very first day after fermentation was discovered and that n-paraffin is being used, under different names, by the pharmaceutical and by the food industry and is absorbed by man as such and not filtered through yeast.

In conclusion one can well say that proteins from n-paraffin can substitute, within certain limits and subject to certain integrations, the traditional proteic sources.

In the second case, the counter party has the right to pretend other guarantees. In this connection it may be noted that, as a consequence of some recent events, partly natural and partly of a speculative nature, feeding stuffs producers would be agreably to pay any price for any material containing proteins. Two different levels of acceptability, in other words, and two answers to two different listeners.

Although it is correct to say that microorganisms transform the substrata on which they grow, it seems unlikely to obtain a toxic product from a non toxic substratum.

The broth in which the yeasts are growing consists of water, n-paraffin and mineral salts. The substance which, in theory, might preoccupy is the n-paraffin which, since it originates from crude oil, might contain some toxic residuals such as aromatics and heavy metals. The characteristics of the n-paraffin obtained by the Union Carbide process are shown in table 1. As regards mineral salts, these cease to be toxic at the very same moment when the residuals contained in the final products are reduced into well defined limits.

TABLE 1

NORMAL PARAFFINS

(Fermentation Grades)

$C_{12} - C_{18}$

N-paraffins, wt %	98,5 min
Total aromatics, ppm	50 max
Isoparaffins + naftenics, wt%	balance to 100
Sulphur, ppm	10 max
Bromine index	30 max
Saybolt colour	25 +

Aromatics (more than four rings)

Ultraviolet absorption spectrum value

Wave Length	Cell 10mm
280 - 289 millimicrons	0,15 max
290 - 299 "	0,12 max
300 - 359 "	0,08 max
360 - 400 "	0,02 max
3,4 Benzopyrene (AOAC method)	1ppb max
20 Methylcholanthrene (AOAC method)	1ppb max
1,2,5,6 Dibenzanthracene (AOAC method)	1ppb max

HEAVY METALS AND OTHER ELEMENTS

METALS	CONTENTS (ppm)	DETECTION LIMIT (ppm)
As	ND	0.01
Pb	ND	0.1
Cd	ND	0.05
Cu	0.22	0.05
Zn	ND	0.025
Mn	ND	0.025
Se	ND	0.5
Sb	ND	0.1
Hg	ND	0.25

Note: ND = not detected

One can say that although chemical and biological parameters are available to evaluate the purity and the non-toxicity of the substances used in the fermentation process, there is no protocol for the so-called conventional protein sources.

This leads to conclude that the question of making yeasts from n-paraffin acceptable to the end-consumer (i.e. man) is only a matter of promotion, whilst its official acceptability is only a question of choice of methods.

As regards the evaluation of the final product, the documentation submitted for the final approval basically consists of two parts. In part one it is analittically demonstrated that the product does not contain any toxic substances or, if so, in such percentages which are far below the limits of toxicity. The biological tests on laboratory or farm animals at short and long term are described in the second part. In Italy, the use of S.C.P. from hydrocarbons, is regulated by decrees. In particular, the one concerning yeast on n-paraffin establishes that:

A - the DENOMINATION OF THE PRODUCT should be:

Yeasts cultivated on n-paraffin

B - DESCRIPTION AND FORMULA

Meal from dried yeasts of the "Candida" species. The substratus should not contain more than 50 parts per million aromatics.

In particular, as far as the purity, the identification and the limits of acceptability of polycyclic hydrocarbons (f.i. 3,4 benzo-pyrene, 1, 2, 5, 6 divebenzoanthracene and 3, methylcolantrene) are concerned, further reference has to be made to a previous decree in which the limits of toxicity are in any case wide enough apart to allow the use of n-paraffin.

C - CHARACTERISTICS (on the dry products) AND APPLYING CONDITIONS

1- Characteristics (on the dry product)

a) average contents in aminoacids expressed in grams x 16 grams of nitrogen:

Aspartic acid 9,40 - Threonine 5,10 - Serine 4,70 - Glutamic acid 13,80 - Proline 4,40 - Glycine 4,40 - Alanine 6,10 - Cystine 1,80 - Valine 5,40 - Methionine 1,20 - Isoleucine 5,50 - Leucine 6,20 - Tyrosine 3,30 - Phenylalanine 4,40 - Tryptophan 1,20 - Lysine 7,50 - Histidine 2,20 - Arginine 4,50

b) n-paraffin residues in 100 grams of the product:
max. 0.5 grs.

c) acceptable quantities of: (ppm)
Sb 0,2 - As 1,5 - Cd 0,2 - Hg 0,1 - Pb 2,5 - Se 1,0

2- Applying conditions

10% max for broilers and layers

7% max for pigs and veals

In any case the Methionine must be added to feeds.

D - DISTRIBUTION

1- The following data must be quoted on the packings:

a) analytical data

- moisture
- crude proteins
- lipids
- fiber
- ashes
- PNE

b) applying conditions

2- Packings containing mixed animal feedstuffs must carry the name of each product therein contained, in order of decreasing percentage.

Controls will be made by competent Authorities to check the characteristics of the product and the purity of the yeast species used.

Everybody knows that crude oil results from the decomposition of vegetable and animal substances in a succession of metabolic stages and use of carbon anhydride drawn from the atmosphere and the sea.

Broadly speaking this means that the use of crude oil to grow yeasts and later on proteins serves to close a biochemical cycle, no matter if this happens in a period of millions of years.

N-Paraffins, in particular, i.e. saturated hydrocarbons responding to the general formula $CH_3(CH_2)_XCH_3$ have the same chain $-CH_2$ as fatty acids to be found in substances of animal origin from which are probably derivated by de-carbo-oxilation.

It is probable that in a not too distant future the consumption of these new proteins for human nutrition may become a "must". It is therefore desirable that the consumer should be aptly prepared.

In this connection I beg to quote Prof. Ferrando's words at a recent meeting on the use of S.C.P. as food:

"It is strange to hear so many discussions about these new protein sources whilst nobody worries about yeasts grown on convertional substrate. If our traditional food and above all the substrata of the classical yeasts were to go through the same tests to which yeasts grown on hydrocarbons are subject, we would, no doubt, experience some very unpleasant surprise."

CONCLUSION

Any change in the nutrition field is looked upon with suspition by the consumer. Even if it does not concern him in a direct way. It suffices to think of the diffidence with which we look at new dishes when travelling abroad. The man of the street does not realise that the zootechnical production is bound by the supply of certain raw materials and breeding systems. He remembers with nostalgia the products of that familiar breeding which today would be an economical and social nonsense. It is therefore only obvious that the consumer, in a psycological situation as outlined at fig. 3 should look with suspicion at SCP from n-paraffins as feed and especially food.

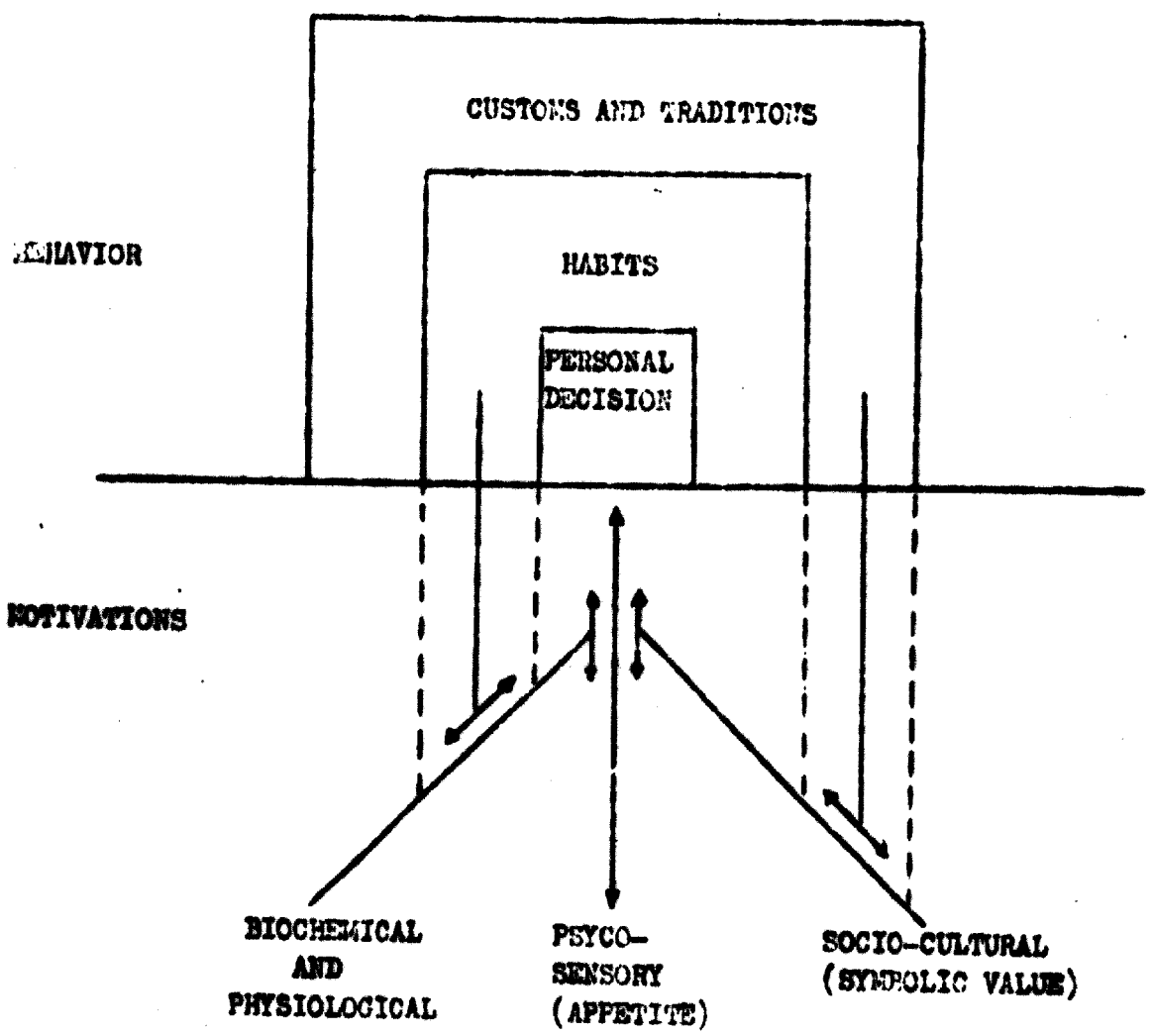
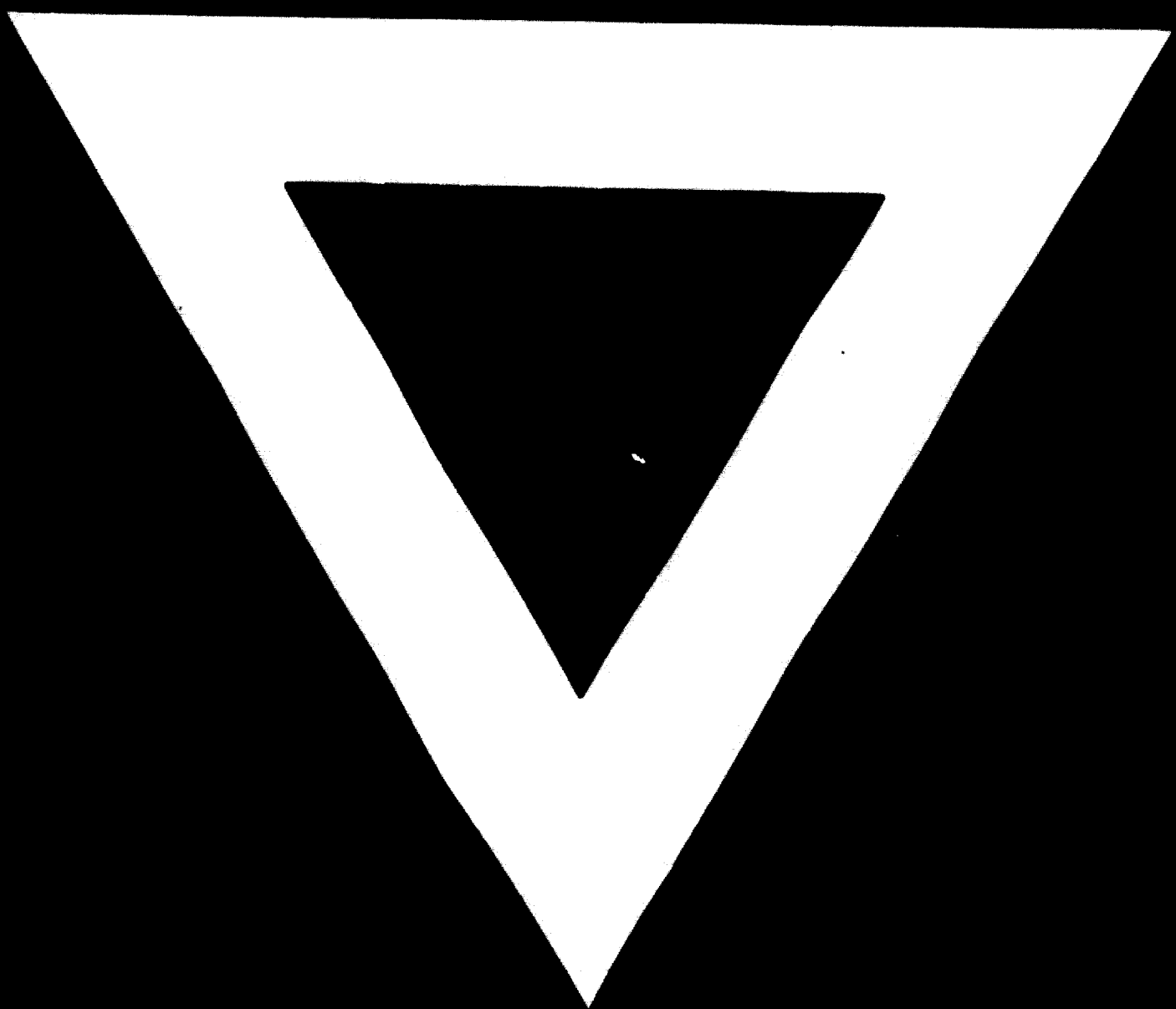


Fig. 3 - Kan's food behavior



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