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PROBLEMS EXPERIENCED IN THE OILSEED AND VEGETABLE OIL PROCESSING INDUSTRY

PRODUCTION OF COTTONSEED OIL IN EGYPT 1/

by

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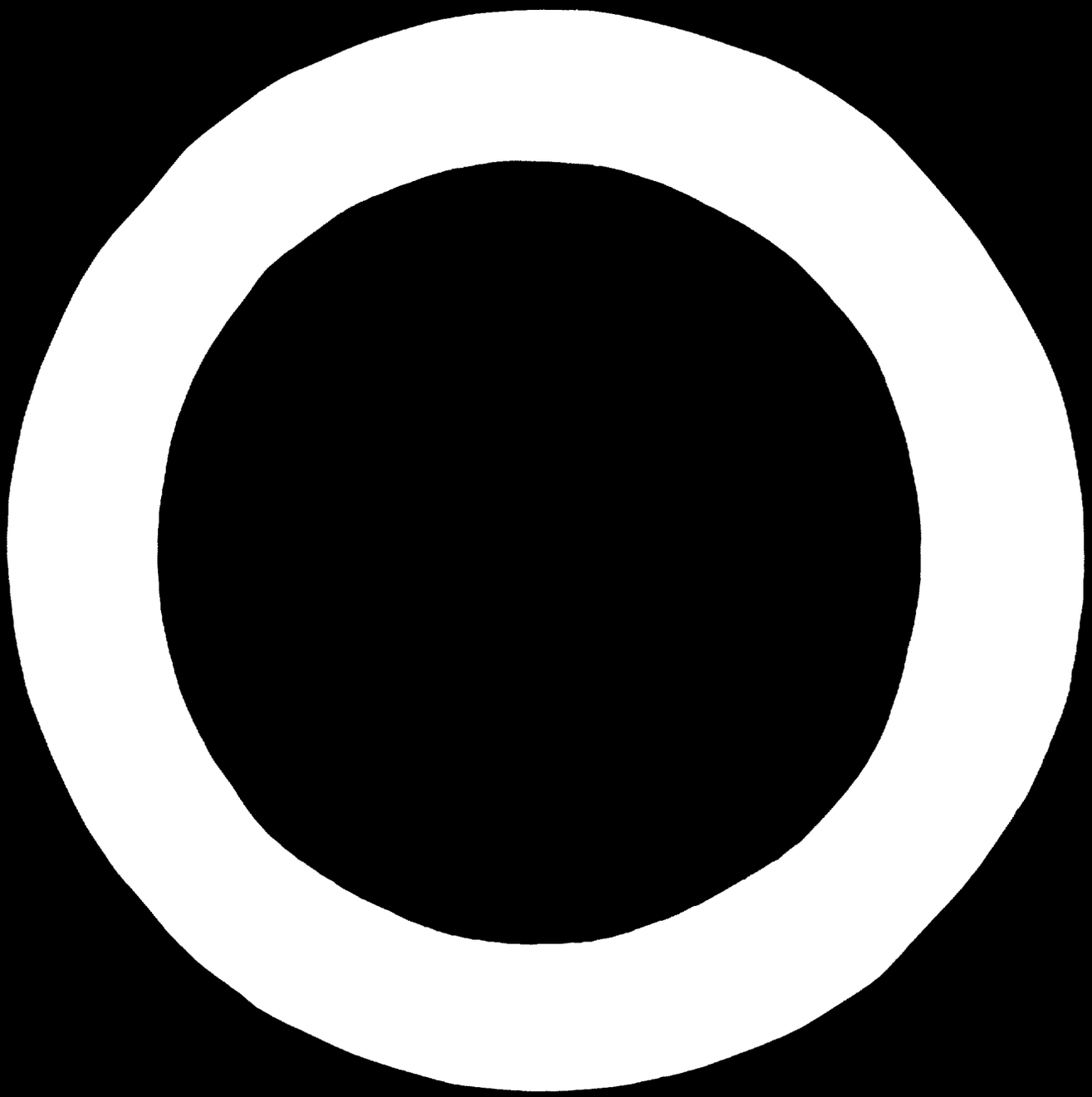


Cotton is the main crop in Egypt. Cottonseed is the main source of oil and cake which satisfy the needs of human and animal consumption in the country.

The history of the oil industry in Egypt started with the ancient Egyptian civilization. It is recorded that the Pharaohs extracted certain vegetable oils for human consumption such as, lettuce oil, safflower oil, rapeseed oil, olive oil, castor bean oil and sesame oil. They also used linseed oil either for edible or painting purposes.

The use of vegetable oils was limited because animal fat, derived from milk, represented the majority of the consumption.

Egypt started growing cotton for the first time in 1820. The cotton was mainly planted for its lint and in those days it was not known how to produce oil from its seed. The climatic conditions favoured cotton plantation and its cultivation increased progressively with the growing demand throughout the world.

The estimated amount of the harvest in 1820 was about 1,000 Kentars as compared with 10 - 11 million Kentars in 1970 (one Kentar = 157.5 Kilos).

The average content of one Kentar of seed cotton ranges from 100 - 105 kilos of seed. With continuous increases in the cotton cultivated areas, and larger harvests each year, the ginning industry commenced operation. The products are mainly lint, and the seed representing the by-product. The possible uses of the seed were not known then. The seeds were exported to Europe, and the imported cottonseed oil was not commonly known as such, but was known as "French oil" after the country of production, which was France. With the increasing interest and European spinners demand, breeders started to produce lint of different specifications to supply the market with the required qualities. Enormous developments took place in the production of a large number of varieties with varying qualities as regards length, strength and fineness.

The oil millers became interested in the cottonseed and its valuable products and the processing of the seed attracted them. Our interest, as oil millers, was to get seeds with a high oil content, but that did not interest the growers because any increase in the oil content is at the expense of the lint yield.

The following tables below illustrate the characters of some Egyptian cotton varieties.

Variety	Moisture %	Crude Protein %	Oil content %	Ash %	Carbo-hydr. %	Crude Fibre %
Ashmouni	8.85	17.94	25.15	4.23	25.53	18.3
Karnak	7.75	16.71	24.71	4.14	27.68	19.54
Menoufi	8.83	22.55	22.55	4.27	27.04	18.47

The hull percentage is known to differ among varieties as shown below:-

Characters	Giza 47	Giza 45	Giza 68	Ashmouni
Seed index (grams)	10.84	10.01	11.10	10.92
Hull percent	35.25	36.74	37.27	38.30
Oil percent	23.81	25.02	22.99	21.68
Protein percent	28.63	25.18	27.45	27.83

It is also interesting to know that the oil content of seeds differ among varieties and also among the same variety cultivated in different areas in upper and lower Egypt as illustrated below:

Average oil percentage on a dry basis for the varieties of cotton at three locations in two seasons.

Strains	Season 1966			Season 1967			
	Delta	Middle Egypt	Upper Egypt	Delta	Middle Egypt	Upper Egypt	Average
Alex 2	25.15	25.55	16.91	23.85	20.20	17.38	12.51
Alex 3	24.71	25.96	15.87	23.85	21.55	18.01	21.68
Giza 45	26.30	28.06	20.68	23.05	12.45	12.02	23.59
Menoufi	26.83	23.45	16.24	23.05	20.10	18.15	21.29
Giza 68	18.87	18.05	12.08	20.75	19.05	18.02	17.80
Giza 47	23.18	24.56	20.96	22.25	20.88	19.81	21.84
Giza 67	16.96	18.16	13.58	23.55	20.15	18.18	18.38
Giza 69	24.34	23.64	13.86	21.35	18.05	16.78	19.75
Giza 66	25.13	25.96	15.87	22.05	19.85	17.43	21.05
Ashmouni	24.57	18.58	14.15	22.60	19.75	17.42	19.51
Dandara	22.98	23.44	17.69	23.10	21.38	20.40	21.50
Average	23.55	23.22	16.17	22.68	20.22	18.42	20.72

Due to recent efforts, the breeders were able to develop a grossy pol-free variety of Egyptian cotton. This was achieved by irradiating the extra-long variety Giza 45 with radioactive phosphorus at 40 micro curies per seed. The glandless character was found to be dominant and simply inherited. In this respect, it differs from the glandless strains produced elsewhere at present. Bahtim 110, the new glandless variety, is still under examination to establish and identify all its characters before extending its cultivation, as unfortunately, it is a low yielder compared to the commercial varieties. The oil extracted from Bahtim 110 is characterized by the very light colour compared with such extracted from the normal seed. This will help cut the cost of the bleaching process. Also by using less quantities of fuller's earth, the fully refined oil produced will have a good keeping quality. The type of cake produced may be widely used to raise the protein content in bakery products.

SEED AFTER GINNING

Little interest was paid to cleaning the seed in the ginning factories prior to their delivery to the oil mills for oil extraction. The impurities contained in the seed always create a number of problems, mainly during filtration of the crude oil, refining, and consequently, lower the yield of refind oil per Ardeb (one Ardeb = 120 kilos).

The oil millers pointed out to the ginners the importance of cleaning the seed before extraction. Later on, it was agreed to determine exact and precise specifications for the seed to settle the differences between the millers and the ginners. The Egyptian standard specification for cottonseed limited the impurities in the seed to not more than 1%. The process of sieving the seed and separating the impurities paid off in the form of larger yields in crude oil, and consequently, in the cost of the process as shown below when calculated for the whole crop:

Considering a yearly average crop of 6 million Ardebs, and assuming that the average impurities are only 2%, it follows that:

The amount of impurities = $\frac{6,000,000}{8,333} \times \frac{2}{100}$ = 14,400 tons

With only 1% of impurities, the cost will be decreased by:

Cost of transport = 7,200 x 1.2 = 8,640 L.E.

Cost of milling = 7,200 x 3.850 = 27,700 L.E.

Extra amounts of crude oil produced as these impurities retain 50% of its weight in oil = 3,600 x 150 = 540,000

Extra amounts of refined oil produced as the impurities tend to raise the F.F.A. content by 0.5% per year = 750 x 150 = 112,500

Total discount in cost = 688,860 L.E.

This process improved the national economy by six to seven hundred thousand pounds per year in the meantime it decreased the amount of imported vegetable oil by 4,000 - 5,000 tons.

HANDLING OF SEEDS

Cottonseed is packed and supplied to the mills in jute bags of 120k. standard weight. The seed is never handled in bulk to avoid the scattering of seed during transport which may lead to the growth of inferior qualities.

The seed sacks are transported by rail, trucks and barges to the oil mills where they are stored as such for extraction. According to the location of the oil mills, the seed is transported for variable distances as illustrated below:

		Ardabs
1. Quantities transported in the same area with negligible distances		2,500,000
2. Quantities transported for less than 25 Km.		300,000
3. " "	from 25 - 50 Km.	1,100,000
	from 50 - 75 Km.	1,000,000
	from 75 - 100 Km.	500,000
	from 100 - 200 Km.	300,000
	more than 200 Km.	1,200,000

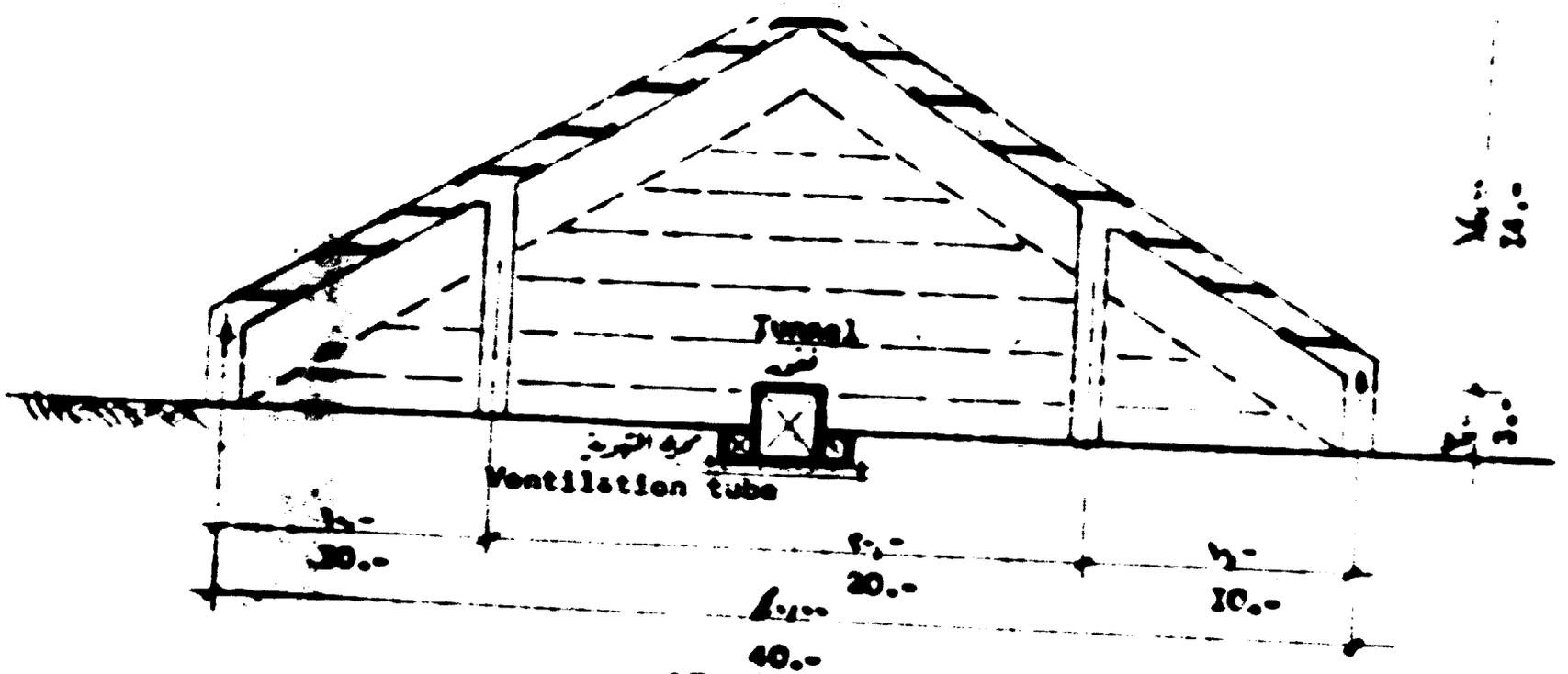
STORAGE OF SEED

The seed is stored in sacks in open areas around or in yards of the mills and partially in closed stores. This type of storage has always led to an increase of the F.F.A. content in crude oil, consequently, in a decrease of the refined oil yield per ton of crude oil.

On estimating our national losses due to this underdeveloped method of storage, the study led to the fact that a decrease in the refining loss by only 1% will save 1,500 tons of neutralized oil. This improves the economical status of the industry as follows:

Net value of the production increase 1,500 x 150	=	225,000 pounds
Depretiation of sacks		200,000 "
Total savings		425,000 pounds

The erection of seed stores in the mills is now included among the State plans to develop the oil industry. We have designed a new type of seed house following the same system of the Muskogee seed house. The new stores are concrete structures with proper means of aeration to prevent the damaging effect of the enzymatic activity on the oil.



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EXTRACTION OF OIL

Cottonseed pressing started in the form of small oil mills erected mainly in Alexandria to press the unexported quantities of seed. Later on, a number of oil mills were established all over the country. The location and capacities of these mills were not properly selected so as to form successful economic industrial units. These mills increased largely in number during and after World War II. They adopted the hydraulic system. 5-10% of the whole seed crop is, at present, decorticated before pressing, the rest of the crop is pressed as whole seed.

The operation of a hydraulic system involves a large number of labourers whose efforts can be considered uneconomical in terms of wages. A loss of about 4 - 5 % of oil in cake adds to the defects of the system. The oil content in the cake, not only constitutes a loss in the yield of crude oil but is also more than required for animal fodder. The new State plans to develop the oil industry gave priority to the replacement of the hydraulic system by the up-to-date continuous solvent extraction system. Some of these units are already functioning, and the remainder of the units are under erection. The location of these units was decided according to the following considerations:

1. The cotton cultivation area was divided into seven sectors. The average yearly crop of seed produced in each sector was estimated according to the capacities of the ginning factories operating in each sector.

2. The quantitites of oil and cake consumed in each sector were estimated.

3. Each sector was provided with enough extraction units to process almost all its seed production.

Accordingly, the transport expenses of both the raw materials and the finished products were cut down to the minimum.

The following table illustrates the fundamental basis upon which the whole plan of distributing the new extraction units, was laid:

Sector	Number of Units	Production Capacity of the Units Ardeb per year	Quantities of seed produced in Ardebs	Quantities of seed consumed in Ardebs
1	1	500,000	600,000	500,000
2	1	500,000	2,300,000	600,000
3	3	1,500,000	500,000	2,300,000
4	1	500,000	600,000	700,000
5	3	1,500,000	1,700,000	1,000,000
6	1	500,000	600,000	700,000
7	3	1,500,000	700,000	1,300,000
Total	13	6,500,000	7,000,000	7,100,000

The investment involved in this plan of replacement amounts to about Egyptian pounds 6 million. The projects are expected to cover their cost in less than two years. It is expected that, after operating these units, an extra yield of 25,000 tons of neutralized oil, worth Egyptian pounds 3,750,000 per year, will be produced.

REFINING

In the early stages of production of cottonseed oil, the crude oil was only de-acidified and consumed as such. It is known as No. 3 oil. The process was carried out in open kettles. With the rising of the consumption rates, refineries began to de-colorize and de-odorize the oil. This quality of oil is known as No. 2 oil. That system of refining prevailed for a long time until the introduction of the winterization process took place in the course of refining to produce the fully refined oil. The batch system was adopted practically in all the operating refineries.

Upon reviewing this system, it became clearly evident that we could achieve much better economical results if we lowered the refining loss due to neutralization. The centrifugal system of operation offered the most suitable means for this purpose. The State's programme for developing this industry included the complete replacement of the open kettle batch systems by the

centrifugal continuous system. The effect of this replacement can be estimated precisely as follows:-

The average difference between the refining loss of the batch and continuous system is about 2.5 - 3.0%. By applying this concept to the quantities of crude oil produced per year, an amount of 3,000 tons of neutralized oil, worth Egyptian pounds 250,000 was saved.

As previously mentioned, the State's planning was directed towards two main objectives, namely:

(1) To minimise the losses of each industrial process to get the largest possible yield of oil from seed;

(2) To produce the best quality of oil according to the Egyptian and international standard specifications.

So far, we have dealt with the problem of increasing the oil yields during the extraction of oil and its neutralisation. The next step, which has already been established in the State's plans for development, was the abolition of the batch systems of the de-colourisation and de-odorization by the continuous systems. By so doing, we will secure a continuous flow of production through the whole system of the refining process. This will also lead to a better quality of oil produced, and will also help to prevent the interoperational storages and handlings.

PACKING

The fully refined oil is loaded into barrels, with standard weights, and transported to the distributing centres. These centres in turn conduct the oil distribution among grocers and from there to consumers. Empty barrels are often reused more than once. Moreover, the process of selling at the groceries involves the use of rather primitive devices to suck the oil from the barrels. Accordingly, the quality of the oil is affected in more than one way. The distribution methods always spoil the concentrated efforts of the refineries to produce the best quality. The problem is now under investigation and it will not be long before we attach new atomatic bottling units to the system of production. The utilisation of polythene or P.V.C. bottles, completely sealed, will offer the most adequate means of handling the refined oil.

THE BY-PRODUCTS

The by-products of the extraction and refining process are mainly:

1. The Oil Cake

The bulk of the oil cake produced was exported, and smaller quantities were used as fuel. At a later stage, the farmers began to use it as a fertilizer for certain crops. During World War II, and owing to the drop in the coal supplies to the country, the exportation of the cake stopped, and it was locally used as fuel and to a less extent as animal feed. As the farmers grew wise to the value of the cake as a rich animal feed, they ceased to use it as fuel , or as fertilizer. The gradual rise in the prices of some crops which served as animal feed, increased the importance of the cake as a cheap alternative. Since the oil cake cannot be considered a balanced feed by itself, we began to mix the cake with other ingredients to offer a proper and balanced fodder. The animal mixed feed industry started to function using the cottonseed cake as a principal component together with by-products from other industries such as wheat bran, rice bran... etc. Mineral salts, calcium and molasses are also added to the fodder. These components together with many other useful additives are locally available. It can be said that a flourishing and successful industry was born, which is attached to the oil production sector of industry in Egypt.

2. The mucilage

The mucilage, which is produced during the caustic neutralization of the crude oil is completely saponified as soap-stock. After bleaching with the hypochlorites, it is used in the manufacture of certain types of kitchen soap, with or without the addition of other oils or tallow. We are now heading towards the process of acidification of the mucilage to split the fatty acids which are distilled. The distilled fatty acids, being of a superior quality to the soap stock, are now used in the manufacture of laundry soaps.

3. Stearine

Stearine is produced from the winterisation process of cottonseed oil. All the quantities produced are used exclusively in the production of laundry soap.

HIGHLIGHTS ON THE EGYPTIAN VEGETABLE OIL INDUSTRY

The vegetable oil industry in Egypt includes: the extraction, refining of oils, hydrogenation margarine, shortenings, processed cheese, soap, glycerine, fatty acids and animal fodder. This sector of industry contributes to a large extent, to supplying the public with their daily requirements. The vegetable oil production in Egypt does not cover the whole consumption requirements; the remainder is imported. The rate of consumption per caput is increasing, parallel to the rise in the standard of living and population which amounts to almost one million per year. Accordingly, the shortage in the vegetable oil supplies will grow larger, necessitating the importation of more quantities of oil every year to compensate for the difference between local production and consumption.

The table below illustrates the situation in this respect in 1965 and 1970 together with the expectations for 1975.

	1965	1970	1975
Population (in millions)	30	34.2	39.6
Rate of consumption (kilo/caput)	8	9	10

This, undoubtedly, will lead to a serious situation in the future, because the local supply of vegetable oils does not grow parallel to consumption.

The solution lies in extending the plantation of other oilseed crops. The State plans are to encourage the plantation of sunflower, safflower, peanut and flax. According to our estimations, we shall be able to cover most of our needs of vegetable oils, from local production, in approximately ten years time.

QUALITY CONTROL

Although industry has devoted great interest in utilising all new machinery in the field of processing cottonseed oil, it did not overlook paying due interest to quality control. Companies devote great interest in controlling the intermediate steps of the process, as well as the finished products. Quality control is the determining factor to guarantee better processing, and ensuring the introduction of saleable products, in accordance with standard specifications and long keeping quality which allows for longer storage time.

The quality control process can be defined as follows:

(1) The seed operated is examined regarding the following properties:

- oil content
- moisture content
- impurities
- F.F.A. in oil
- protein

The grade quality is thus determined. The sampling takes place at the ginning factories, upon arrival at oil mills, and during seed mixing prior to extraction.

(2) Routine samples are withdrawn to follow-up the industrial process. At the end of each process, sampling and determination of oil content takes place as follows:

- F.F.A. percentage
- moisture
- colour

The values are plotted on the control charts of the process to detect any deviation. The withdrawal of samples and methods of analysis are conducted according to the A.O.C.S. specifications.

(3) The fully refined oil is examined according to standard specifications. At regular intervals, oil in the distributing centres and at the grocers, is sampled and analysed. Any off-grade quantities are withdrawn immediately from the markets and re-refined.

(4) Determination of the consumption rates of ingredients takes place to ensure its effective utilization. These rates affect the economical condition of the whole operation, since some of these ingredients are imported.

THE ECONOMICAL IMPORTANCE OF THE VEGETABLE OIL INDUSTRY

The vegetable oil industry is considered one of the most important food industries in the country. It affects the supply and strategic situation. The total production value of this sector amounted to Egyptian pounds 60 million per year according to the latest statistical data. This value is calculated according to the local prices of the products. However, these prices are lower than the international prices of similar products. The difference is due to the priced system. Sometimes, the prices of some products are less than its cost.

The production value, of the oil industry sector, represents 12.5% of the total production value of the food industry: rice and wheat milling are excluded. It also represents 3% of the total production value of industry.

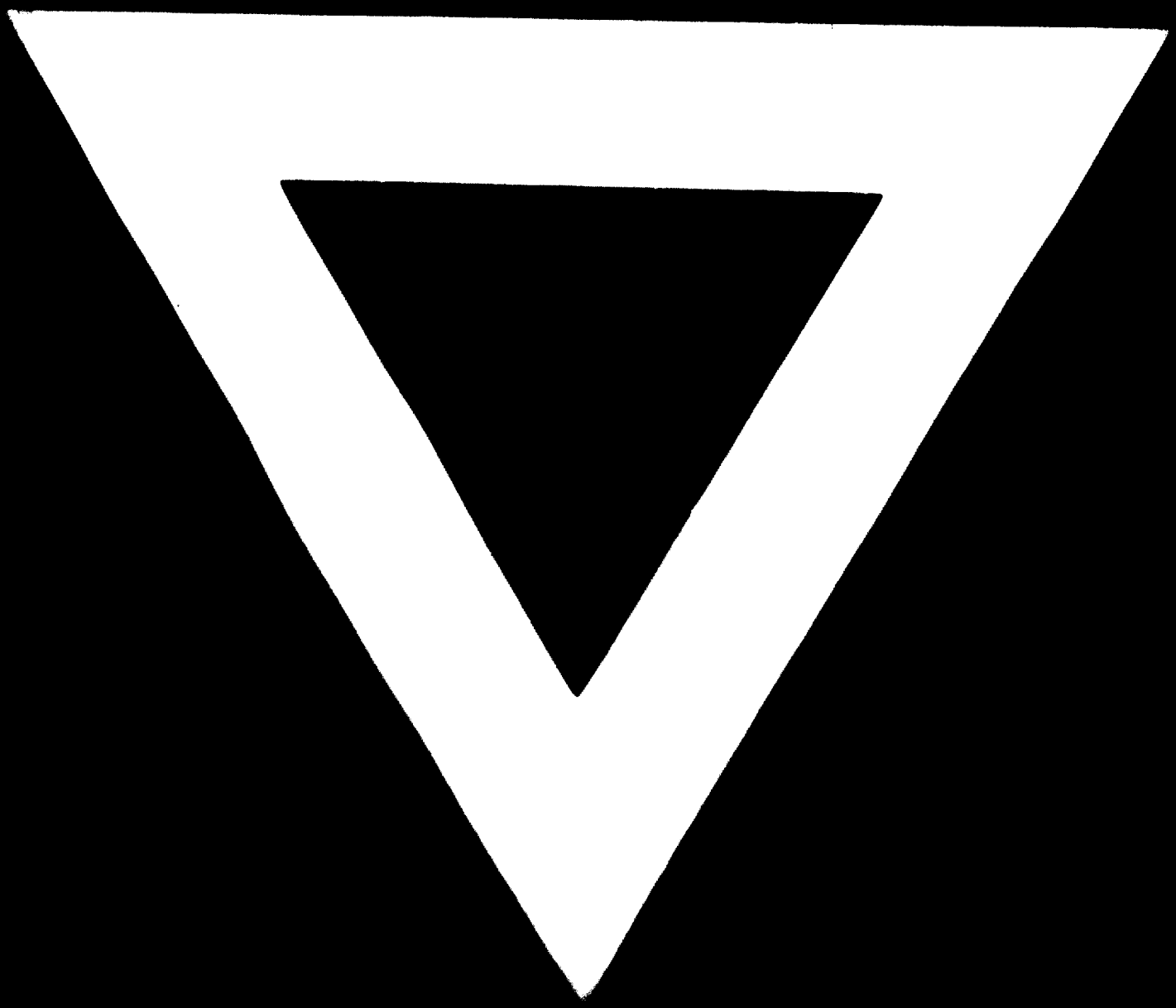
Owing to the application of the priced system for the raw materials and products, the ratios of performance evaluation will differ to a large extent, from those of the free market system where the rule of the supply and demand prevails.

The table below furnishes the average ratios of productivity recorded from the oil industry sector:-

Ratio	Average	Upper limit value	Lower limit value
1. Return of investment = net profit / capital invested	12.1	36.3	1.0
2. Profits to sales = net profit / net sales	6.5	20.6	0.9
3. Sales to capital invested = net sales / capital invested	1.9	5.5	1.1
4. Labour productivity = net production value / number of labourers	2,300	2,715	1,326
5. Productivity of wages = net production values / total wages	9.8	13.2	6.4
6. Productivity of capital invested = net production value / capital invested	1.9	3.6	1.1
7. Degree of technology = total fixed assets / total wages	1.7	3.1	0.6
8. Degree of manufacture = values of utilized resources / net production value	69.2	80.7	45.1
9. Fixed assets ratio = fixed assets / total assets	30.8	47.5	17.7

Ratio	Average	Upper limit value	Lower limit value
10. Financing of fixed assets = fixed assets / net worth	92.4	371	34.8
11. Liquidity = current assets-stock / current liabilities	51.2	102.8	23
12. Turn over of working capital = net sales / fixed assets	2.1	3.7	0.9
13. Fixed assets = net sales / fixed assets	3.2	7.2	1.5
14. Sales to production = net sales / net production	98.9	118.3	87.8
15. Local sales = sales in the local market / total sales	97.4	100	83.4
16. Overtime = cost of overtime / total wages & salaries	4.4	8.8	0.9

This quick review of the cottonseed oil industry reveals a picture of that industry and its development to match similar industries in industrially developed countries. This is but a step on the road to ensuring enough vegetable oils which are required to secure food for all, which is one of the objectives of the United Nations.



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