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THE PEANUT

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INTRODUCTION

The peanut is a pea or leguminous plant belonging to the same family as beans and garden peas. It differs from the other legumes in that it possesses the character of developing its fruit beneath the surface of the soil.

The peanut requires a growing season of approximately 90 to 150 days. The crop cannot withstand frost and requires an abundance of sunshine, adequate rainfall during the growing season, and a relatively high temperature. Peanuts grow more satisfactorily on a light sandy soil and the best yields are obtained when the annual rainfall is from 48 to 54 inches, however, fair yields have been reported when the rainfall has been approximately 18 inches.

Two very important factors in the growing of peanuts are: (1) the adaptability of the soil; and (2) the type of crops planted or the system of rotating crops that has been followed. Peanuts should not be planted on the same plot of land more often than 3 years straight, and the planting preceding the peanuts should be kept clean of weed. The thorough preparation of the land before planting goes a long way toward the assurance of a good stand and the elimination of weed problems.

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Fertilizing

There is no standard rule for the fertilizing of peanuts because the kind and quantity of commercial fertilizers used depends upon the soil of the particular area. A very poor quality of peanuts has resulted from the application of nitrogen to a fertile soil. A fertilization program for peanuts requires a study of the soil to determine the elements that are lacking and to supply them. On heavy fertile soils acid phosphate is the only fertilizer recommended. It has been found that peanuts are improved in quality by the application of lime to soils deficient in calcium.

Selecting Seed

The selection of peanuts for seed should be carried out with great care and with the view of continuously improving the crop and of having the peanuts possess the qualities desired. After the selection has been made they are air dried, by the customary method, for 4 to 6 weeks and then the seed peanuts are picked from the vine and stored in a dry cool place protected from insects and rodents. The seed peanuts are prepared for planting several weeks before the field preparation has begun, that is, the seeds are shelled and all inferior ones are removed.

The time for planting peanuts in this country is between April 10 and May 10. The date for planting is determined by the accumulation of heat by the soil.

Planting

The planting distances for peanuts vary considerably and depend to a large measure on soil fertility and the variety being planted. Satisfactory yields and growth results have been obtained by planting shelled peanuts, 4 inches apart in the rows separated by 24 inches. The quantities of seed per pound for small and large variety seed are 60-80 and 70-125, respectively. The seed are covered to a depth of 1 to 1½ inches with slight firming of the soil.

*This Bulletin was in the process of being prepared before Dr. George W. Carver's death on January 5, 1943.

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Protecting Seed

The protection of the seed from rodents, can be accomplished by sprinkling a mixture of equal parts of pine tar and kerosene over the seed before planting.

Cultivating

The cultivation of peanuts cannot begin too early. It is important that the soil be kept free of weeds and from forming a crust. The soil must remain loose to enable the flowering stems to penetrate and form the seed. The fruit of the peanut will not form unless the flowering stem enters the soil.

Harvesting

The time to harvest the crop can be determined by the yellowing of the foliage and by the examination of the pods. If the inside of the shell begins to show color and darker veins the crop can be harvested. If the plants are dug too early many of the pods are not fully developed and if dug too late germination of some varieties will begin.

The peanuts can be dug by hand with a sharp implement, a plow designed for the removal of the plant and pods with a portion of the root with nodules remaining in the soil, or the potato digger, which accomplishes the same feat as the plow but with greater speed in the removal of excess soil. After the peanut plants have been removed from the soil and excess dirt shaken off they are left on the ground before stacking, to permit the leaves to wilt. Stacking for curing can begin after the leaves of the plants have wilted.

In curing peanuts they are put in small stacks around poles to which boards have been nailed at right angles and at a height of 7 inches from the ground. The pole is usually 7 feet in length and the cross-pieces 15 to 18 inches. These poles are set firmly in the soil to prevent the stacks from being blown or knocked over.

The stacks are made by first putting the vines over the cross-pieces to make the foundation and then continuing to add the plants, with pods always toward the pole, to within a few inches of the top of the pole. The last few inches on the pole are reserved for a cap of grass for the shedding of water. The vines remain in these stacks from 4 to 6 weeks depending upon the weather conditions.

The picking of peanuts, i. e., the removal of the pods from the vines by hand or machine, is done during the months of October, November and December. The average capacity of peanut picking machines is 250 bushels per day.

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The peanuts, after being removed from the vine, are bagged and stored in shelters that can be protected from rain, mice and rats, and are stacked to permit the free circulation of air.

Marketing

Peanuts, after leaving the grower, are carried through a cleaning process to prepare them for market or other methods of utilizing them in the industry. Peanuts leave the storage bin and are passed into a dirt reel which has small openings to permit the dirt to pass through. Some cleaning plants have cylinders for the removal of sticks and other foreign matter from the peanuts. Then to remove lightweight materials and trash not eliminated by the cylinder the peanuts are passed through one or more blasts of wind. The peanuts that are to be roasted in the shell are carried through a stemming process to increase their salability.

Fans and aspirators are important in the cleaning of peanuts and are used extensively. The proper regulation of fans improves the efficiency of the plant by removing stems, chaff, empty pods, and other materials not usable in the manufacture of food products.

Grading

The separation of peanuts in the shell into various sizes and grades is done with a machine designed on the principle of a series of sieves. In this way the peanuts are separated for diversion into the channels—oils, peanut butter, salted nuts, roasted nuts—that they are suited for. The final step in the selecting of peanuts for marketing in the shell is hand picking. The peanuts pass on a conveyor before workers who remove discolored or defective pods. This is the final step in the cleaning and grading of peanuts for sale in the shell.

Shelled peanuts are customarily those that are made from lots of stock peanuts that are on a whole inferior in size, weight and appearance, and those that are used in the confectionary trade for the making of peanut butter, and for oil.

Cleaning

The peanuts to be shelled are cleaned as previously described or forced into a shaft with an air current moving upward that lifts the peanuts and light particles of trash, but permits the stones and heavy particles of foreign matter to drop to the bottom and into a receptacle for trash.

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Shelling

The shelling of peanuts varies considerably in this country. A few plants use a semi-circular iron container 3 or 4 feet long, lined with $1\frac{1}{2}$ inch iron bars of irregular widths, varying from $\frac{1}{4}$ to $\frac{1}{2}$ inch. Revolving in the container is an iron shaft to which are attached four beaters that are spaced equidistant from each other and which strike and crack the hulls of the nuts. Some plants use a series of perforated oscillating screens and controlled air currents. Other plants use whirling circular corrugated plates, vibrating screens, and air currents. The screens are used to separate the shelled nuts into the various grades and designate them for the respective uses for which they can be utilized. After the shelled nuts have been screened and cleaned by air currents, it is necessary to run them on conveyor belts for hand picking to remove inferior nuts. The undesirable nuts are placed with the oil stock.

Roasting in Shell

One of the most common products of the peanut trade is peanuts roasted in the shell. The roasting of peanuts is done in perforated revolving cylinders over some type of heat. This heat can be supplied by gas, electricity, coal or wood. The r.p.m. of the cylinder will vary from 6 to 10 for small batches of 5 to 10 pounds to 50 to 60 for quantities of 60 to 200 pounds. The length of time required for roasting is determined by temperature, moisture content of the pods, size of the roaster, and quantity of nuts being roasted. Roasting of large batches can be completed in 20 minutes at high temperatures. The loss in weight of peanuts during the roasting process is from 7 to 10 per cent.

Salted Peanuts

Salted peanuts have been a popular item with the general public. The Spanish variety of peanut with the red skins retained has been used extensively for salting purposes. The nuts to be salted are cooked in oil. Peanut oil has proven satisfactory for this purpose. The length of time that the peanuts remain in the oil depends upon the temperature of the oil. The temperature of the oil should be 250°F and the cooking of 150 pounds of nuts should be completed in approximately 15 minutes. Upon being removed from the vat the peanuts are suspended to permit the drainage of the oil and then they are placed in revolving drums, to which salt is added at the rate of 1 to $1\frac{1}{2}$ pounds per 100 pounds of peanuts, until the nuts

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and salt have been thoroughly mixed. Following this step the salted nuts are ready for packaging.

Blanching

The blanching of peanuts is a process for the removal of the thin red skins on the nut. This skin is removed in the preparation of the nuts for various purposes and at the present time, in the making of peanut butter. The blanchers in use are: (1) a series of fine brushes running on pulleys and revolving in opposite directions, and (2) two roller belts made of thick rubber and ribbed with a series of transverse grooves, and which revolve closely together but in opposite directions. The red skins are separated from the nuts by suction and the whole and broken peanuts are added to the oil stock.

Peanut Butter

Peanut butter is made by grinding the roasted blanched peanuts and adding from 1½ to 3 per cent of salt during the attrition process.

The blanching of peanuts for butter differs from the method previously described in that in addition to the removing of the red skins the nuts must be split and the heart must be removed. The excess of hearts in peanut butter promotes early rancidity and imparts to the butter a bitter taste. The blanching and the removal of the hearts of peanuts is accomplished by passing the peanuts between two belts, the upper one being stationary and the lower belt mobile. The hearts and red skins are separated from the nuts by screening and a current of air. The nuts before being ground pass over a conveyor belt picking table which permits workers to remove any foreign matter still present and discard any inferior nuts before they are delivered to the mill.

Peanut Butter Mills

The peanut butter mills have automatic salt feeders which allow definite proportions of salt to be fed into the mill along with the nuts. The mechanism of the mill is a revolving screw that forces the peanuts through a pair of ribbed grinding discs into a discharge spout. The containers are generally filled directly from the spout.

Food Value

In 28.35 grams of peanuts there are: 92 international units of thiamin (Vitamin B1), 57 international units of riboflavin (Vitamin G),

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small quantities of Vitamin A, 7.3 grams of protein, 6.97 grams of carbohydrates, 11.03 grams of fat, .02 grams of calcium, .116 grams of phosphorus, .65 grams of magnesium, iron, and 156 calories. The peanut contains the nutritionally essential linoleic acid, and the 9 to 10 amino acids necessary in nutrition are represented. These figures and facts indicate the importance of the peanut as a valuable source of a highly nutritive food.

In Candy

The peanut is used extensively in the making of candy. A few examples will be stated to give some idea of the magnitude of the uses in the making of candy: chocolate-covered peanut bars, plain peanut bars, peanut brittle, sugar-coated peanuts, etc.

Peanut Oil

Peanut oil is extracted, by hydraulic or expeller presses, from varieties of peanuts of a high oil content and grown for that specific purpose or from those peanuts that are discarded from the edible trade.

Peanuts to be crushed do not require as elaborate an outlay of cleaning equipment as has been described for the preparation of peanuts for roasting or processing into food products. The peanuts are run through the dirt reel and shaker to remove the stones and trash and then into the shellers, which are equipped with fans for the removal of the shells. Often the nuts are directed over a magnet to remove any pieces of iron that might be present.

Oil Extracting

The hydraulic press is found to be more generally used in the extraction of peanut oil than any other type of equipment.

The peanuts in preparation for pressing, after the cleaning and shelling have been completed, are cracked and then passed through rollers to rupture the oil cells to assure a more efficient removal of the oil. The pulp is conveyed from the rollers to a cooker, remaining in the cooker for approximately 20 minutes, from there to the cake former and then placed in one of the compartments of the hydraulic press and subjected to a pressure of 4,000 pounds. This pressure is exerted for approximately 20 minutes. The oil removed runs down the sides of the press and into a drain and is in some cases filtered to remove particles of meal, but the most common practice is to pump the oil directly from the drain into the storage tanks and allow the foots to settle. This method necessitates the periodic cleaning of the foots from the storage tanks.

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After the pressure is released the cakes, which are 14 inches wide and 30 inches long, are removed from the press and then run through attrition mills for grinding into meal.

The expeller press for the extraction of oil is being used more extensively in the modern oil extraction plants.

The peanuts are shelled, cleaned, ground and then fed into the cooker to condition the meals to the proper moisture content and temperature for the best removal of the oil by the expeller. The peanuts are forced by an automatic feeder screw to the expeller barrel. The ground nuts are crushed in the expeller barrel. The oil comes out through the steel space bars of the barrel and is pumped through a filter press to the storage tanks, and the cake is discharged and conveyed to the attrition mill for grinding.

Solvent extraction, because of operation costs, has not been adopted for the removal of peanut oil.

The advantages of the hydraulic press type of mill are:

1. The investment cost is low because of the simplicity and cheapness of apparatus required.
2. Steam consumption is very low.
3. There are no parts which wear down quickly and must be replaced.
4. The capacity of the mill is readily increased by the addition of another press at small cost.

The disadvantages of this type of mill are:

1. The cake shows a high residual oil content which represents a financial loss and is also undesirable from the standpoint of stock feeds.
2. The protein in the cake has been coagulated.
3. The press cloths are expensive and wear rapidly.

The advantages of the expeller press are:

1. Labor costs are low because of continuous operation.
2. Steam costs are low because prolonged cooking is not necessary.
3. There are no press cloths to replace.
4. A cake is produced which is highly digestible.
5. Plant expansion is easy because space requirements are negligible.
6. A plant using a single expeller requires only a small investment.

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Disadvantages of the expeller press are:

1. Large amounts of oil are left in the cake.
2. Larger power is required than for the hydraulic press.

The crude peanut oil, whether extracted by hydraulic presses or expeller presses, must be refined to remove free fatty acids, coloring matter, albuminous and mucilaginous materials that will be present. The residue resulting from the refining process is designated as soap stock and is used in the manufacture of soap and glycerine.

Refining of Oil

The crude oil after being treated with caustic soda separates into refined oil and soap stock. The refined oil is pumped off and washed several times with water to remove particles of soap. The oil is dried under vacuum. Then mixed with bleaching agents; the mixture is then pumped through a filter press which retains the bleaching agent and permits the passage of clear bleached oil. This oil is then ready for use as a cooking oil, salad oil, margarine, medicinal oil, and in the formulation of cosmetics.

Peanut oil has a digestibility of 98.3 per cent which makes it very valuable as a food.

Analysis and Physical Constants of Oil

Glycerides of	Oils From
Unsaturated Acids*	Spanish Peanuts
	Per cent
Total	77.6
Oleic Acid	52.9
Linoleic Acid	24.7
Saturated Acids	
Total	21.5
Palmitic Acid	8.2
Stearic Acid	6.2
Arachidic Acid	4.0
Lignoceric Acid	3.1
Unsaponifiable Matter	0.2

Some of the important characteristics of peanut oil are as follows:

Iodine Number—89 to 96

The iodine number of an oil indicates the class to which an oil belongs. Oils possessing an iodine number below 100 are considered

*Vegetable Fats and Oils, G. S. Jamieson, 1932 p. 137.

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non-drying oils. Iodine numbers from 100 to 130 indicates semi-drying oil; and those above 130, drying oils. As indicated above the peanut oil is a non-drying oil.

Saponification Value—186.6—188.4

The saponification number indicates the milligrams of potassium hydroxide required to saponify one gram of a fat or oil.

Titer Test—30. 5-32.0° Centigrade

In the commercial valuation of fats and oils or fatty acids to be used in the manufacture of soaps, the solidification point of the fatty acids is known to the industry as titer test.

Smoke Point—450-470° Fahrenheit

The smoking point is the lowest temperature at which the oil decomposes sufficiently to produce smoke. The smoking point of peanut oil is high and is for that reason a valuable oil for cooking purposes.

Most of the peanut oil produced is used for food purposes—salad-dressing, cooking, and margarine but is used to a limited extent in the making of soap, medical preparations, emulsions, is sulphonated to use as a detergent, and is used as a fuel for Diesel engines.

Diesel Fuel

The results of studies on the use of peanut oil as a Diesel fuel do not indicate that it offers any difficulty or drawback, that is, if it is to be used in areas where peanut oil is plentiful, inexpensive, oils that are more efficient for this use are not available, and are too difficult to obtain. The consumption of peanut oil is higher than that of mineral oil, is more difficult to start, and the engine develops less power.

Peanut Meal

The peanut cake is the solid residue resulting from the crushing of peanuts in the hydraulic press and expeller press. This cake is ground into a meal and is sold as a stock feed. The meal is sometimes sold as a fertilizer.

The peanut meal is valuable as a stock feed because of its high and very digestible protein content. The protein content of the meal is reduced to predetermined percentages for stock fed, by the incorporation of ground peanut hulls.

Peanut Flour

This peanut cake, if care in cleaning and selection of peanuts is

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followed, and sanitary methods are adopted in processing, it can be made into flour.

Analysis of peanut flour is as follows:

Ingredients	Percentage
Moisture	6.94
Fat	8.98
Protein	59.79
Crude Fiber	0.66
Nitrogen Free Extract	19.56
Ash	4.07

The peanut flour, which contains more than four times as much protein, eight times as much fat, and nine times as much minerals as white wheat flour, can be made into bread and pastries by blending it with wheat flour or sweet potato flour.

It has been found that 7½ ounces of peanut flour will relieve symptoms of pellagra.

Peanut Hulls

The peanut hulls which are a by-product of the shelling process are used as a soil conditioner, bedding for livestock, floor sweeping compound, and buffing for steel mills.

The peanut draws very heavily upon the soil nutrients, and can create a very serious soil fertility problem. A program to prevent the destruction of a soil by a single crop system of farming cannot be over emphasized. The conservation of the soil must be a segment of any production program.

The peanut meal resulting from the extraction of the oil is a very valuable feed for livestock. The protein content of the meal that is partially free of oil is too concentrated and, therefore, it is necessary to incorporate ground peanut shells into the meal as filler and to add roughage.

Peanut shells can be used for the following purposes: (1) in the production of insulating boards; (2) in the making of fuel briquettes; (3) in the preparation of sweeping compounds; (4) as a soil conditioner. Three tons of peanut shells are equivalent in heating value to 1 ton of coal.

Uses for Peanut Oil

Peanut oil can be used for frying, for making salad dressing, cosmetics, massaging, emulsions, a carrier for adrenalin and bismuth, soap, insecticide, as a Diesel fuel, and sulphonated for detergent purposes.

For an area where peanut oil is plentiful and inexpensive the re-

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sults of laboratory investigations on the production of low boiling point fuels might be considered of sufficient value to warrant pilot plant installations to exploit this possibility to its fullest extent.

Peanut oil on cracking in the liquid phase, with aluminum chloride as catalyst, under a pressure of 400 atmospheres produces 27 per cent refined gasoline, 31 per cent refined illuminating oil, and gas, coke, and distillation residue which are of good fuel value.

Additional Uses

Peanut meal is used extensively as a stock feed and is just beginning to be manufactured to a limited extent into a flour. The meal can be used as an adhesive and also made into numerous food products. The processing of the meal into flour requires more careful grinding and the removal of larger particles by air currents rather than the usual procedure of bolting.

In the preparation of bread 20 per cent of peanut flour or meal is incorporated with 80 per cent of wheat flour. Very satisfactory breads and pastries have been made by adding 35 per cent of the peanut flour or meal with 65 per cent of sweet potato flour or meal.

Sweet potato meal or flour is made by dehydrating and then grinding the sweet potatoes. The flour is produced by bolting.

Peanut oil has in some instances been substituted for the fat that recipes call for.

Shelled peanuts placed in boiling water for a few seconds to remove the red skins can be ground to the consistency of peanut butter and then added to breads with very satisfactory results.

Whole shelled peanuts can be cooked with vegetables to supply fat and to substitute for meat.

Peanut "milk" made from blanched and ground peanuts can be used as a beverage or substituted in recipes requiring milk. The "milk" is prepared by grinding the peanuts and adding 2½ quarts of water to each pound of peanuts. This mixture is heated at 100°C for 20 minutes with constant stirring and upon the completion of the heating the mixture is cooled and salt and sugar are added to taste. In the preparation of this "milk" mashed bananas have been added and the mineral content has been supplemented.

Peanut cheese is made from the "milk" by keeping the "milk" in a warm place until the curd is formed, which would require overnight, or by the addition of vinegar to the "milk." After the curd has been formed it is placed in cheese cloth and allowed to drain. After the

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liquid has been removed the curd is seasoned with salt and stored in a cool place or cooked immediately.

The residue resulting from the preparation of the "milk" or curd can be used in the making of meat substitutes, and in flavoring paste.

Peanut sprouts are also a very wholesome adjunct to the diet.

In Bulletin Number 31 there can be found 105 Ways of Preparing the Peanut for human consumption.

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