

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources*. AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP-42 Section Number: 9.10.2.2

Reference Number: 1

Title: Peanuts: Production, Processing,
Products, 3rd Edition

Woodroof, Jasper Guy

AVI Publishing Company, Westport,
CT

1983

Production PEANUTS: Processing Products

SECOND EDITION

by JASPER GUY WOODROOF, Ph.D.

*Alumni Distinguished Professor
Emeritus of Food Science,
University of Georgia,
Experiment, Georgia*

in collaboration with specialists

WESTPORT, CONNECTICUT

THE AVI PUBLISHING COMPANY, INC.

1973

most popular for salting peanuts, with a decided dropping off (in favor of sweets) during December and January.

Consumers Reports (Anon. 1964) found that 14 brands of mixed toasted nuts had 55% salted peanuts. The Bureau of Home Economics (1938) prepared 11 recipes for using raw shelled peanuts in the home.

ROASTING PEANUTS FOR SALTING

Peanuts for salting may be dry roasted as described for peanut butter. Dry roasted peanuts are sometimes glazed with $1\frac{1}{2}$ to 2% of a special oil and mixed with $2\frac{1}{2}$ % of salt without blanching. However, a more common practice is to blanch them before applying the oil and salt.

The initial quality of peanuts for salting should be very high and equal to that of peanuts for candies.

The most common practice is to blanch the peanuts, then oil roast or fry in oil. In this case they pass directly from the blancher to the fryer, which may be a double-flue, thermostatically-controlled, gas-fired continuous cooker of the Fryolator type. Cooking temperature is 280° to 290°F. , and the time is from 3 to 10 min., depending on the variety and degree of doneness.

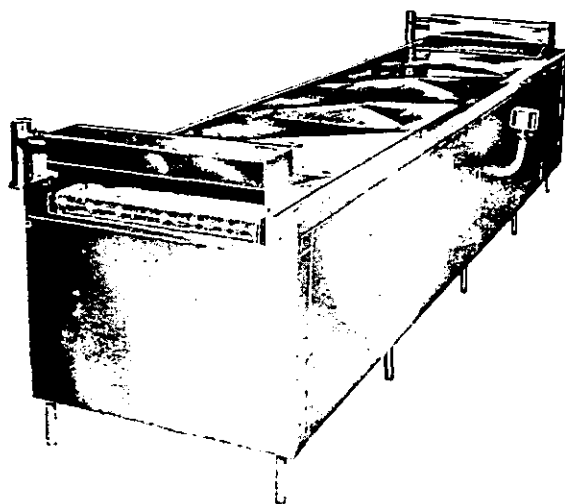


FIG. 67. CONTINUOUS OIL ROASTER FOR PEANUTS

Roasting is continuous, clean, labor saving, and utilizes heat transfer fluids which in turn heats the cooking oil. The customer has the option of using gas, oil, or electric heat.

tact with the hot surface. Charred meal imparts a dark color and bitter flavor to the oil and peanuts. The bottom of the oil roasting tank should be shaped like a V with a drain at the lowest point, permitting the meal to be flushed out with a minimum loss of oil. Coconut oil is best for roasting nuts, though modified oils of cottonseed or peanuts are good. There should be a system of continuous filtering and neutralization. At the end of each day the oil should be filtered, neutralized, and held in a closed tank at about 200°F. This is to prevent peroxidation in the oil and condensation of moisture. Fresh oil—about 10%—should be added daily.

Oil should be added as necessary to keep level up to desired point, and drained for replacement with new oil when signs of thickening, nonuniform browning, or excessive foaming are observed. Best results are obtained by continuous draining and replacement of part of oil, to keep free-fatty acids within a 0.2 to 0.3% range, as free-fatty acids above 0.4 to 0.5% usually produce uneven browning of nuts.

Oil roasted blanched peanuts should be cooled, salted, packaged and handled with a minimum exposure to heat, air, and light.

BLANCHING PEANUTS FOR SALTING

Until about 1940, many salted peanuts had skins and hearts intact. Improved mechanization for blanching changed this, so that blanching always precedes oil roasting, but usually follows dry roasting. Most salted peanut kernels are blanched or whitened by removing the red skins and hearts. Blanching cleans the kernel of dust, mold, possible filth, or other foreign materials, hence is thus a major operation in the manufacture of salted peanuts. The skins of peanuts contain tannin and the hearts contain a bitter principle. Therefore, the flavor of blanched peanuts is milder than that of the unblanched. There are at least four methods of blanching.

Blanching peanuts for roasting differs from blanching for peanut butter, in that for salting the hearts are usually not removed, while for peanut butter the hearts are always removed. Dry blanching removes the hearts and skins, while water blanching, spin blanching, and alkali blanching remove only the skins.

X Dry Blanching

Dry blanching is accomplished by heating the shelled peanuts to 280°F. for up to 25 min., depending upon the variety and degree of doneness desired, to loosen and crack the skins. After cooling, the peanuts are passed through the blancher in a continuous stream and subjected to thorough, but gentle rubbing between brushes or ribbed rubber belting. The

then on a knobbed conveyor they pass under an oscillating canvas-covered pad, which rubs off the skins. The kernels are dried from a moisture content of about 12 to 6%, by a current of 120°F. air, over a period of at least six hours (Lawler 1961).

Water-blached peanuts have a shelf-life longer than that of un-blached nuts, and many salters in this country and Europe are going to this method. The spray of hot water dissolves some of the surface protein, and upon subsequent drying a glaze is formed on the surface which is a

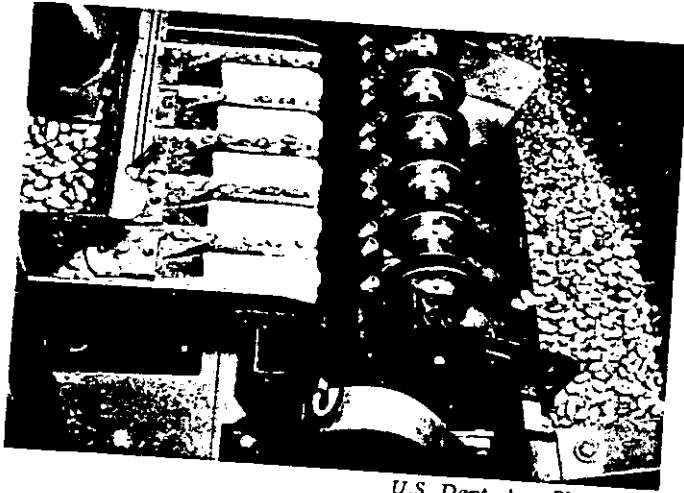


Courtesy Seabrook Blanching Corp.

FIG. 70. DUMPING PEANUTS FOR WATER BLANCHING

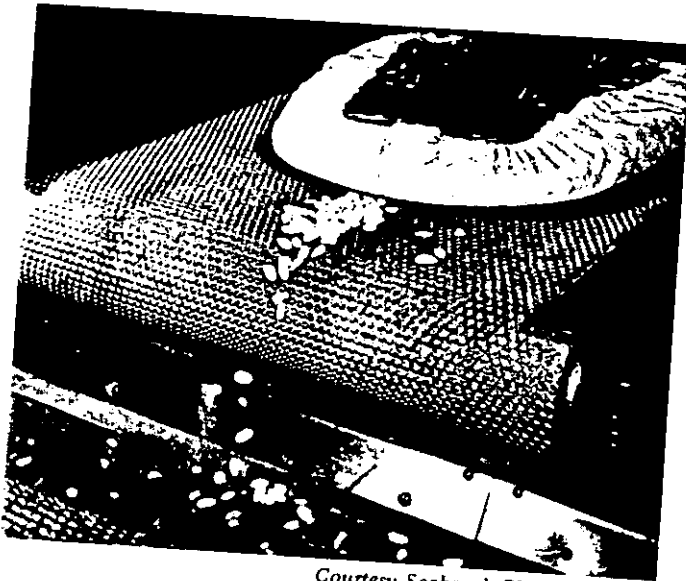
Each load of peanuts at water blanching plant is segregated to avoid mixing. Dumper starts load through process from these rooms. Production capacity is 6,000 lb. per hour.

protection against oxidation and mechanical injury. Whole, water-blached Virginia or Runner peanuts are superior for salting, though the process is more expensive than dry blanching.



U.S. Dept. Agr. Photograph

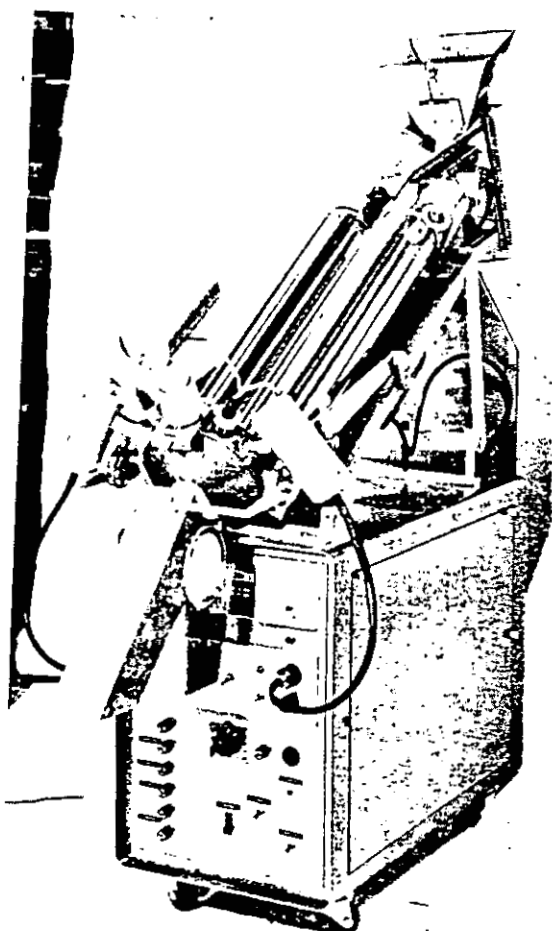
FIG. 73. SLITTING PEANUT SKINS FOR WATER BLANCHING



Courtesy Seabrook Blanching Corp.

FIG. 74. CLOSE-UP OF WATER BLANCHING SCRUBBER

One way of removing skins from peanuts is by gentle rubbing between cloth and soft rubber.



Courtesy Gromax, Inc.

FIG. 76. SELECTOR FOR ELECTRONIC GRADING OF PEANUTS BY SEPARATING THOSE THAT ARE OFF-COLORED

y definite number of kernels per pound. Following is the approximate number of kernels per pound of a few varieties and grades:

	<i>Per Pound</i>
Little White Spanish	2,000
Regular Spanish	1,100
Dixie Runner	1,050
Regular Runner	980
Virginia	
Shelled	
No. one	864
Medium	640
Extra large	512
Unshelled	
Fancy	225
Jumbo	176

A description of the use of the most recently developed zein-acetylated mono- and diglyceride coating for peanuts was obtained from Justin J. Allison, The Al-Chem Laboratory Inc., Bloomington, Ill.

Zein is a special alcohol soluble protein derived from corn, having characteristics similar to shellac. It is a bland, edible, nutritive protein that can be used without limitations as to amount. It has been used for many years for coating nuts and confections to extend the shelf-life.

When used alone, as a coating, zein is quite brittle and tends either to chip off, check or mar the surface. This has been overcome by the addition of alcohol soluble acetylated glycerides as a plasticizer. The new coating provides resistance to moisture, vapor, and oil and gives an excellent finish to the product.

The shelf-life of coated salted Spanish peanuts was extended 3 to 4 times, and that of coated salted Virginia peanuts was extended five times, beyond that of corresponding uncoated peanuts.

There are several methods of applying the coating to either dry or oil roasted peanuts. (a) The preferred method is the use of a standard confectioners revolving pan or cylinder. The coating is applied either by spraying or pouring three pints (0.5%) of the liquid on 100 lb. of peanuts while they are being tumbled. The nuts are allowed to dry and a similar amount of liquid is added along with the salt.

(b) A second method of application is to spray the liquid on the nuts while moving on a wire belt, allowing the nuts to tumble onto a second and third wire belt, to insure complete coating.

(c) A third method of coating is the use of mixing spirals, flights, worms, or conveyor feed screws. The coating is sprayed on the nuts as they are tumbled.

In either case, the alcohol in the coating is allowed to evaporate overnight before the nuts are packaged. Precautions in handling and storing the coating material are that it be held at 65° to 80°F., for not more than three months. It will solidify below 65°F., and irreversibly gel at 95°F. or above.

Shea (1965) has developed a new coating method for peanuts and other nuts. The process is said to retard rancidity, clean, pasteurize, and enhance the appearance.

The coating is a combination of distilled acetylated monoglycerides, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and citric acid. The coating is colorless, tasteless and transparent, and is used at the rate of 1 to 5%, depending on the surface area of the nuts.

The coated nuts (a) have long-term stability against rancidity which ranges up to six months at room temperature; (b) have very low microbiological counts; (c) are clean and free of rancid nut oil, dirt, loose skins,

d other fragments; and (d) retain their light color, as the coating protects the tannins in the skin from oxidation. The treated nuts are excellent dry mix products, retail packages, use in confections and in bakery or other processed foods.

Salting Peanuts

At times, nut salters are bothered somewhat because the salt falls off the surface of the salted nuts and into the bottom of the bag or can, principally because of rough handling in shipping. This difficulty is more likely to be encountered where nuts are fried in liquid oils rather than solid shortenings. Where nuts are fried in solid shortening, the salt is applied before the nuts have cooled down to room temperature. At this point the binding fat is still in a melted condition on the surface of the nuts. When the nuts cool down to room temperature, the shortening on the surface sets up as a solid fat. The salt is thus held firmly to the surface of the nuts and will stay there in spite of considerable handling. This is also true in the cases where nuts are fried in coconut oil, since coconut oil sets up at approximately 76°F. Below this temperature coconut oil is a fairly firm fat. Where nuts are fried in cotton-seed oil, peanut oil, olive oil, or other oils that are liquid at room temperature, there is very little binding action to hold the salt on the surface of the nuts.

Some nut salters dry roast the nuts rather than fry them in oil. In this case, there is no solid fat to help bind the salt on the surface of the nut, and the little binding action observed is caused by the trace of natural nut oil which comes to the surface during the roasting period.

The following suggestion will correct the difficulty of the salt falling off the nuts to the bottom of the bag. When the warm nuts are removed from the kettle and drained, or where they are removed from the ovens after roasting, spread them on the table and let them cool slightly. Then, spread on the surface of the nuts about 2 lb. of warm coconut oil (about 100°F.), or a similar dressing, for each 100 lb. nuts. The proper product to use is regular coconut oil which is often referred to as "76° Coconut Oil." It is not necessary to use plasticized coconut oil since the regular product will be entirely satisfactory. Because the nuts are considerably warmer than the oil, it will be noted that the oil does not seem to penetrate the nuts, but remains on the surface. After the coconut oil is uniformly distributed on the nuts by mixing, the salt is added and the nuts are then allowed to cool down to room temperature. It will be found that after this treatment the salt will adhere to the nuts very well, thus overcoming the difficulty of the salt rubbing off. Freshly harvested nuts do not hold the salt as well as nuts that have been cured for a considerable period of time. It may be that the high moisture content is responsible.

y are made by the Alberger salt-refining process (Anon. 1965D) are flashers are used. There are little crevices and indentations on the faces of the tiny flakes that permit the fat on the surface of the nut to "ch hold" on the salt particles, binding the salt firmly to the surface of nut.

It is generally recognized in the trade that when nuts are salted with these there is instant solubility, uniform granulation and high purity, and lips are not irritated by the salt.

Since peanuts are rich in oils, and since copper and iron accelerate acidity of fats and oils, it is essential to use a salt with a minimum content of copper and iron impurities. The best salt products are quality controlled to contain less than 1.5 p.p.m. copper or iron on the average. Because sodium chloride gives the flavor which is wanted with nuts, it is important that the calcium and magnesium impurities be kept to a minimum. Calcium chloride, for instance, will contribute a harsh flavor to a product; therefore it should be kept as low as possible. It is also important to note that a greater amount of salt can be used if the calcium chloride is kept at a minimum. This is of economic importance to the nutter.

Nuts are salted at a level of about two per cent. This may vary somewhat with the processor or salter and his geographic area and the taste preference of his customers. The salt is fed from a hopper onto the hot peanuts freed from excess oil.

One fine flake prepared salt on the market has the following chemical and physical properties (Courtesy Diamond Crystal Salt Co.):

Chemical Properties

NaCl	(Salt)	99.95 ± 0.01% ¹	
CaSO ₄	(Calcium sulfate)	0.02–0.06%	
CaCl ₂	(Calcium chloride)	0.00–0.02%	
MgCl ₂	(Magnesium chloride)	0.00–0.01%	
Na ₂ SO ₄	(Sodium sulfate)	None	
Cu	(Copper)	Less than 0.00015% ¹ (1.5 p.p.m.) on the avg.	
Fe	(Iron)	Less than 0.00015% ¹ (1.5 p.p.m.) on the avg.	
Moisture		Less than 0.1%	
Insoluble matter		Less than 0.002% (20 p.p.m.) ¹	
Contains as free-flowing agent:			
1.0% TCP (Tricalcium Phosphate)			
Range:	Min.	Avg.	Max.
	0.95%	1.0%	1.10%

¹ Before conditioning.

ons contain one or more of these phenolics, plus a synergist or metal activator to enhance their antioxidant properties.

These materials usually are marketed and used in two forms—as liquid solutions of basic antioxidants because of better solubility in fats, and as solid formulations of pure antioxidants or blends, where solubility is not a great problem.

Nuts treated with BHA and BHT (also BHA and propyl gallate) show good resistance to rancidity. Where the nuts are to be sprayed, combinations of BHA and BHT are favored because of their extreme solubility in vegetable oil and ease of handling. Propyl gallate tends to discolor in contact with metal spray equipment, hence is not recommended for this application.

Antioxidants may be applied to roasted peanuts in three ways.

(1) Adding antioxidant to the cooking oil. While this may seem a good way to treat peanuts, experience has shown that the addition of 0.125 to 0.25% of antioxidant (24.8% propyl gallate, 22.5% citric acid, and 52.7% propylene glycol) to the cooking oil will not materially retard rancidity in roasted peanuts. The continued cooking at 325° to 375°F. diminishes the activity of the antioxidant. Moreover, the mixture tends to discolor the oil. Other antioxidants including BHA and BHT have been successfully added to the cooking oil, but are better used in other ways.

(2) Adding antioxidant to the salt. This has been found to be an easy and effective way to use antioxidants on roasted peanuts. A mixture is prepared of:

	<i>Lb.</i>
Propyl gallate	24.8
Citric acid (anhydrous)	22.5
Propylene glycol	52.7
	100.0

The addition of 405 lb. of the above concentrate to 100 lb. salt yields a free flowing product. This salt may be used on peanuts at the rate of 2 lb./100 lb. of peanuts. The shelf-life of peanuts with salt containing antioxidants may be more than doubled that of nuts with untreated salt (Anon. 1965C).

Salts treated with BHA and BHT are on the market and give good to fair results (Stuckey 1956).

(3) Addition of antioxidant to the peanuts. Antioxidants may be "fogged" on the peanuts immediately before salting if desired, as shown in Fig. 82. Double protection is provided if spraying or fogging is used together with antioxidant treated salt. Each treatment may be expected to

HARD PEANUTS

Manufacturers and salters prefer tender, crisp peanuts with relatively soft texture. Hard, tough, or gummy peanuts are objectionable for most edible purposes. Hardness is associated with physiological development during late maturity and rapid curing of peanuts which adversely affects practically every desirable quality.

Hardness in Spanish, Runner, and Virginia types of peanuts was studied in relation to maturity, methods of curing, methods of grading, storing, sensory values, and chemical composition. The following results were obtained:

- (1) Hardness is found predominantly in small, shriveled, and immature peanuts, and very rarely in large, smooth, fully mature kernels.



FIG. 83. PEANUTS "FRECKLED" DUE TO UNEVEN MOISTURE DURING ROASTING

Peanuts developed "freckles" and cracked when oil roasted with too high moisture, and darkened in the center when the sugar was high.



FIG. 84. NORMAL AND "HARD" VIRGINIA PEANUTS

Peanuts roasted frequently become hard and twisted.

The same phenomenon of "horny" texture may occur if normally cured peanut kernels are re-wet as in water blanching or dip coating and subsequently dried or roasted at high heats. Also, hard texture and actual warping may result if kernels contain more than 7 to 8% moisture from curing or storage and subjected to the usual roasting or oil cooking processes. Such hardening of wet starch or protein materials when rapidly "baked out" to very low moisture levels is common in many types of food products.

PACKAGING SALTED PEANUTS

Until about 1930, most salted peanuts were unblanched and sold either in bulk or from vending machines "for a penny." Much of the salt rubbed off the nuts and collected in the bottom of the package or machine.

Development of automatic packaging machines with or without vacuum, along with improvement in salting technique, changed methods of packaging, and retailing salted peanuts. Salted peanuts are sold in bulk, blanched or unblanched, alone or in mixed nuts; (b) packed in flexible glassine or cellophane bags to be sold for 10 or 15¢ and eaten from the bag; (c) packed under vacuum in tin cans or glass jars of many sizes and designs, to be eaten from the containers or used in many kinds of dishes.

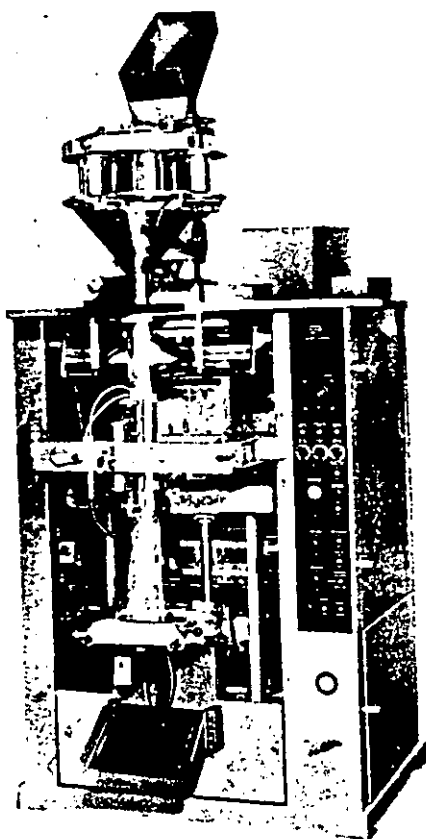
The shelf-life of salted peanuts is extended by improved packaging in that both air and light can be greatly reduced, insects may be controlled, and moisture absorption may be eliminated. Hermetically sealed packages render inert gas packing possible, but is of no advantage with vacuum packaging.

According to Stuckey (1959) the effective use of antioxidants in packaging materials to increase shelf-life depends on two major factors. First, the determining factor for the short shelf-life must be oxidative breakdown in the fat itself. In many cases, staleness, moisture pickup, texture loss, and carbohydrate breakdown reduce the shelf-life of a product and the inhibition of fat oxidation is only academic. Fat breakdown manifests itself as a sharp rancid odor only in the final stages. Earlier stages are characterized by loss of odor and flavor as well as various off-odors and -flavors. The second factor to be considered is the ratio of the package surface area to fat content of the food. In bulk packages it is difficult to apply sufficient antioxidant to the inner surface of the package to stabilize all of the fat against oxidative breakdown.

Antioxidants are applied to packaging materials in three ways, depending on the type of package. In plain carton stock or chipboard, the antioxidant is roll coated onto the sheet from an emulsion after the last calendering operation. Emulsion concentrate containing either BHA or BHT are

SALTED PEANUTS

219



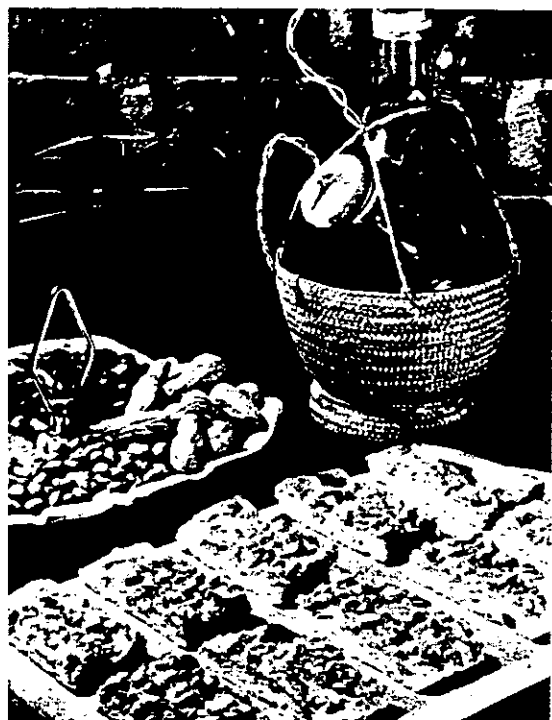
Courtesy Triangle Machinery Co.

FIG. 87. MACHINE FOR AUTOMATICALLY FORMING, FILLING, SEALING POLYETHYLENE BAGS WITH SALTED PEANUTS



U.S. Dept. Agr. Photograph

FIG. 88. AUTOMATIC WEIGHING AND PACKAGING SALTED INSHELL PEANUTS IN CELLOPHANE BAGS



Courtesy National Peanut Council

FIG. 90. PEANUT PIZZA, SERVED WITH INSHELL AND SHELLD
SALTED PEANUTS, AS A SNACK

The second is a method of packing roasted peanuts in pouches of laminations of cellophane, aluminum foil, and polyethylene, and flushing with inert gas.

PEANUT VENDING MACHINES

The attractive peanut roasting machines that sat on street corners four decades ago distributing fresh roasted inshell peanuts for a nickel a bag were appropriate forerunners of modern vending machines.

The immediate forerunner of the vending machine for salted peanuts was glass jars, which sat on the counter, and holding about a dozen bags. The bags were replenished regularly as the peanuts were sold.

It is reported that out of 20 leading food items sold in vending machines, 14 of them contain peanuts in some form. For vendors, peanuts break down into three categories—peanut butter cracker sandwiches, peanuts in candies, and salted peanuts. Among these, cheese-flavored cracker sandwiches are the most popular, followed by square-cracker peanut butter sandwiches, peanut candies, and salted peanuts. All of these are year-round items and through a schedule of "pick-up," staleness, rancidity, insect infestation, and breakage are not problems. Consumer

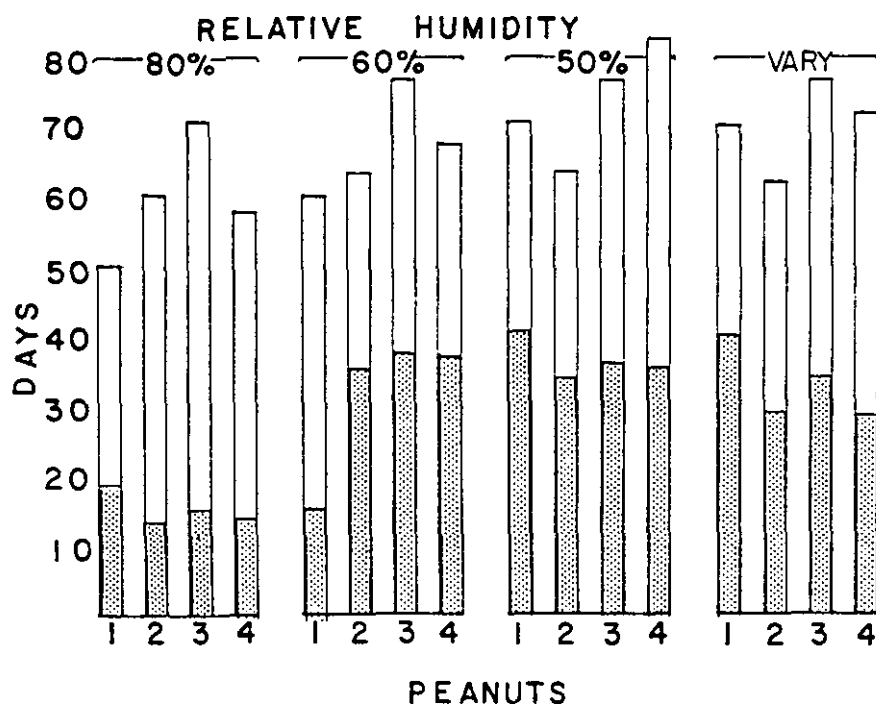
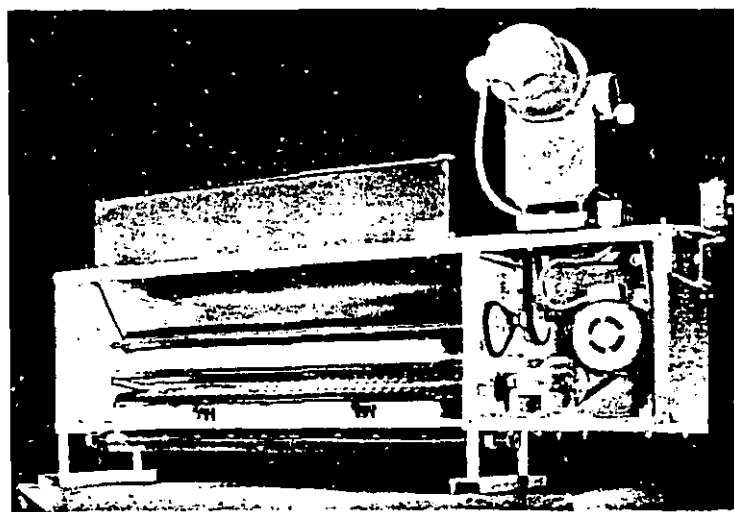


FIG. 92. CHART SHOWING THE NUMBER OF DAYS THAT PEANUTS (1) UNBLANCHED SPANISH SALTED, (2) BLANCHED SPANISH SALTED, (3) UNBLANCHED VIRGINIA SALTED, AND (4) BLANCHED VIRGINIA SALTED; REMAIN FRESH (SHADED) AND EDIBLE (UNSHADED) WHEN HELD AT ROOM TEMPERATURE WITH FOUR RELATIVE HUMIDITIES



Courtesy Morton Salt Co.

FIG. 93. DISPENSER FOR SALTING ROASTED PEANUTS

Interest in de-oiled peanuts is due to possible increase in shelf-life by minimizing oil rancidity, possible use by hemophiliacs to control bleeding, and development of a new product to increase utilization of peanuts.

- ANON. 1965A. A new greaseproof multiwall. *Mod. Packaging* 38, No. 7, 146-147.
- ANON. 1965B. Nut coating process improves shelf-life and appearance. *Food Eng.* 37, No. 4, 124.
- ANON. 1965C. Research reports. Unpublished. The Griffith Laboratories, Chicago.
- ANON. 1965D. Suggestions for nut salters. *Tech. Bull. Misc. Foods.* Diamond Crystal Salt Co.
- BUREAU OF HOME ECONOMICS. 1938. Recipes for shelled raw peanuts. *Peanut J. Nut World* 17, No. 6, 11-12.
- COSLER, H. B. 1958. Prevention of staleness, rancidity in nut meals and peanuts. *Peanut J. Nut World* 37, No. 11, 10-11, 15.
- COX, D. C. 1947. Electric sorting peanuts. *Peanut J. Nut World* 26, No. 4, 27-28.
- GILPIN, G. L. *et al.* 1953. Flavor of peanuts and peanut products as affected by certain insecticides used in growing peanut crops. *Food Technol.* 7, 132-135.
- GREEN, P. 1955. Method and machine for removing skins from nuts. U.S. Pat. 2,702,574.
- HALL, L. A., and SAIR, L. 1950. Use of antioxidants after deep fat frying. *Peanut J. Nut World* 29, No. 10, 38.
- KEATING, R. 1940. Quality of nut roasting. *Peanut J. Nut World* 19, No. 7, 12-13.
- LAWLER, F. K. 1961. Ingenuity creates new process. *Food Eng.* 33, No. 2, 38-40.
- LAWLER, F. K., 1965. Presses calories from nuts. *Food Eng.* 37, No. 9, 138-139.
- LEFFINGWELL, G. 1946. Glycerin in nut products. *Peanut J. Nut World* 25, No. 10, 25.
- MASON, M. E., and WALLER, G. R. 1964. Isolation and localization of the precursors of roasted peanut flavor. *J. Agr. Food Chem.* 12, No. 3, 274-278.
- PICKETT, T. A., and HOLLEY, K. T. 1952. Peanut roasting studies. *Georgia Agr. Expt. Sta. Tech. Bull.* 1.
- POMINSKI, J., PATTON, E. L., and SPADARO, J. J. 1964. Pilot plant preparation of defatted peanuts. *Am. Oil Chemists' Soc.* 41, No. 1, 66-68.
- REEVE, K. J. 1962. Split skins spun off in new nut blancher. *Food Eng.* 34, No. 8, 51.
- SHEA, R. 1965. New edible protective coating keeps nuts fresh. *Food Eng.* 26, No. 5, 148-150.
- STUCKEY, B. N. 1956. Which antioxidants? *Food Eng.* 82, No. 7, 76-77.
- STUCKEY, B. N. 1959. Nut tests prove antioxidant dependability. *Mfg. Confectioners Assoc.* 13th Annual Prod. Conf., Lancaster, Pa.
- TAKEUCHI, A. K., and MAZUMOTO, Y. 1970. New skinning process. *Peanut J. Nut World* 50, No. 1, 12.
- WILLICH, R. K., and FEUGE, R. O. 1957. De-oiling of peanuts to yield a potentially useful food product. *Food Technol.* 11, 332-336.

Willich and Feuge (1957) removed 75% of the oil from whole, blanched peanuts by soaking them at ambient temperature in a suitable solvent, like isopentane or hexane, for 60 hr. The time required increased or decreased with the moisture in the peanuts. By refluxing the solvent, every 3 hr., in stainless steel apparatus, as high as 96% of the oil may be removed.

The color of de-oiled peanuts is almost white; the bulk is about 10% greater; the texture is crisp, with a slight sensation of chalkiness; the flavor is milder, but sweeter; and about 4 hr. is required to remove the solvent from the extracted peanuts.

As the moisture and oil are removed, other constituents rise. De-oiled peanuts contain 60% protein, 5.9% crude fiber, 28% nitrogen-free extract, 6% ash, 9.5% disaccharides, 8.4% starch, and 5.3% pentosans.

Pominski *et al.* (1964) found that de-oiled peanuts were difficult to roast and required special equipment. The time required ranged up to 10 hr. and required batch operation.

De-oiled peanuts are salted by dipping in saturated brine at room temperature for 5 to 10 min. to gain 16 to 20% brine by weight, and then oven-dried. In a second method de-oiled peanuts are dipped in water for 30 sec. to gain 10 to 20% moisture, sprinkled with 2% salt by weight of dry defatted peanuts, and then dried. A third method is to sprinkle the roasted peanuts with saturated brine to produce the desired saltiness.

Roasted peanuts with 80% oil removed are more hygroscopic than normal nuts and require better packaging. Peanuts containing 3% moisture packed in tin cans with 2% nitrogen may remain in good condition for one year. Peanuts with 5.5% moisture are not sufficiently crisp and crunchy to be satisfactory.

Peanuts with smaller amounts than 80% oil removed were spotted and wrinkled. According to Lawler (1965) pressing peanuts removes 80% of oil. The flattened peanuts are reshaped in hot water then roasted in oil. Weight is decreased 30% and cost per pound is increased 8¢. Calorie content is decreased 64% and the nuts are less filling when eaten.

BIBLIOGRAPHY

- ALIKONIS, J. J., and COSLER, H. B. 1961. Extension of shelf life of roasted and salted peanuts. *Peanut J. Nut World* 40, No. 5, 16-17.
- ANON. 1940. New method of removing skins from peanut kernels. *Peanut J. Nut World* 19, No. 3, 23.
- ANON. 1949. Stream lined water blanching machine now a reality. *Peanut J. Nut World* 28, No. 5, 31.
- ANON. 1962. Seedboro offers fast accurate counter for peanuts. *Peanut J. Nut World* 42, No. 2, 9.
- ANON. 1964. Mixed nuts. *Consumers Rept.* 29, 541-543.



Courtesy National Peanut Council

FIG. 91. DESSERTS WITH WHOLE SALTED PEANUTS

Crunchy peanut brittle melts into the filling and drizzles a caramel glaze down the sides of peanut brittle angel cake. If you make the cake from a mix, meringues are made from egg whites left over from the cake filling. Both desserts can be frozen until needed.

interest is maintained by rotating products and samples in the machines. Regional taste preference for peanut products from vending machines are negligible.

Sweet peanut butter sandwiches with malt, cream, or chocolate are less popular, especially during the summer. Roasters, confectioners, and bakers are seeking new peanut base items that may be sold from vending machines. These include "summer" candies, coated salted peanuts, cup candies, old fashioned brittle, panned peanuts, low-moisture fruit cake slices, and others.

DE-OILING PEANUTS FOR ROASTING

There is a demand for roasted peanuts with less oil and fewer calories. This can be accomplished by removing a part of the oil. Solvent extraction removes almost any desired amount of the oil, but results in loss of other constituents as well, chiefly flavors. Mechanical removal of a portion of the oil results in better flavor retention.

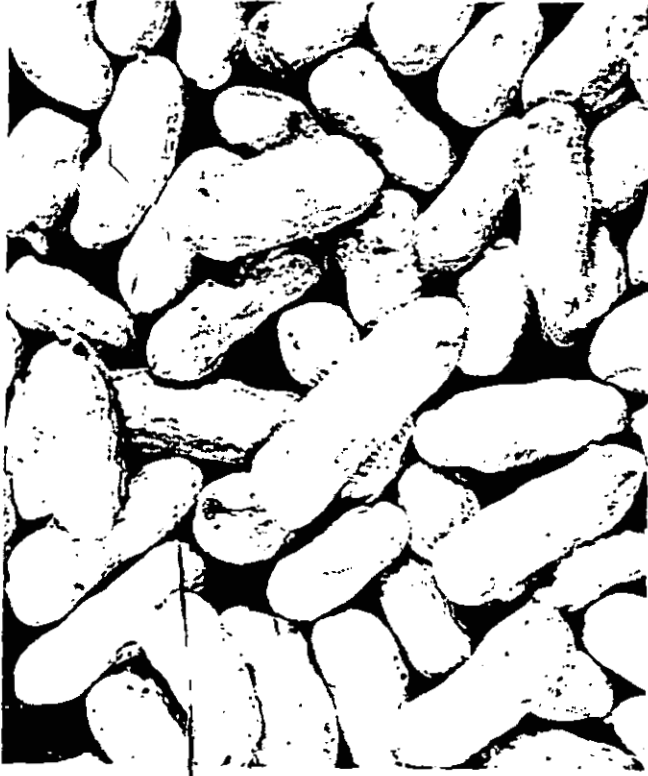


FIG. 89. VIRGINIA-TYPE PEANUTS SALTED IN THE SHELL

container wall. The chemicals (chromium complex of long chain fluorochemical acids) are used to prevent unsightly staining which results when oil penetrates the outer surface of the package. By a new process (Anon. 1966A) the chemical is applied to one side of kraft paper during the paper manufacturing process, and does not touch the nuts or nut products. The inner side, which contacts the products, has a protective barrier of a thin coating of polyethylene. Another kraft paper ply is similarly treated with the fluorochemical on the inside and backs up the first ply. A third ply (reading outward) is conventional kraft and a fourth ply is lined kraft.

The use of the one-side treatment rather than a through-and-through treatment, plus the inner barrier of polyethylene has satisfied the Food and Drug Administration's Regulation 121.2518, under the Food Additives Law.

Two recent innovations have occurred in treating and packaging salted peanuts. The first is the use of monosodium glutamate in the oil roasting process, to enhance the natural flavor, followed by vacuum packing in 1½ open No. 303 cans.

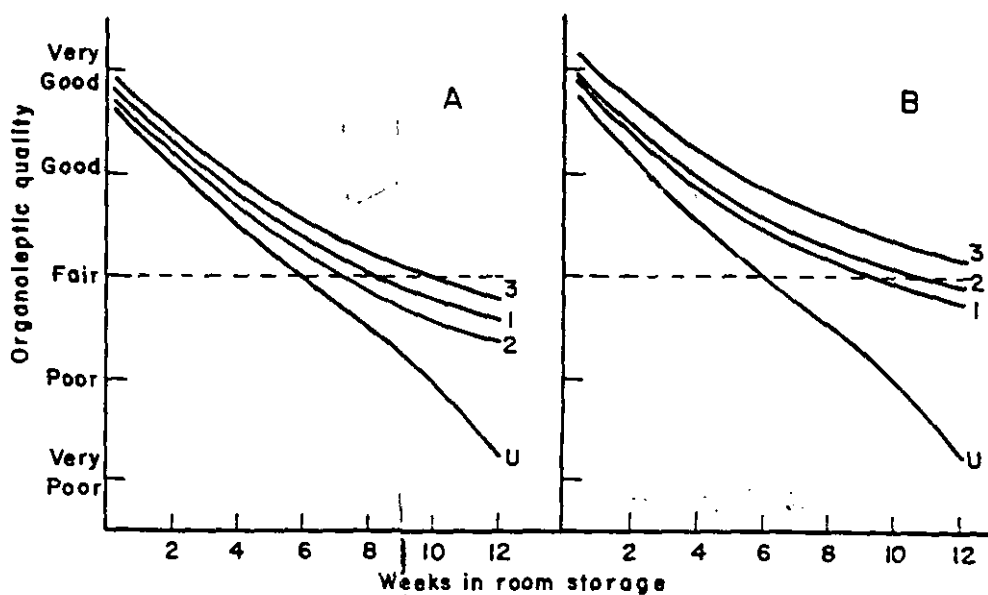


FIG. 86. CHART SHOWING EFFECT OF ANTIOXIDANT ON PEANUT QUALITY

Shown are the effects of BHA on organoleptic quality of blanched, oil-roasted peanuts stored at room temperature with (A) unsynergized BHA and (B) BHA with propyl gallate and citric acid. (U) no antioxidant, (1) BHA in cooking oil, (2) BHA in salt, and (3) BHA in cooking oil and salt.

available for this usage. Antioxidants are also sprayed onto chipboard stock using a solution of BHA or BHT in a food packaging approved plasticizer such as diisobutyl adipate.

Antioxidants are added to waxed paper or board by simply placing them into the paraffin wax in either the storage tanks or the waxing machines. Both BHA and BHT are quite soluble in paraffin waxes, making this method extremely simple. In many cases, wax manufacturers add antioxidant to wax to prevent oxidation with resultant off-odors. The quantity of antioxidant used during processing, however, is so small that additional quantities must be added if food protection is needed.

Polyethylene, cellophane, and other films when used as packaging laminates are treated in a manner similar to that described for chipboard and waxed stock. Antioxidants are added to polyethylene immediately before film extrusion. Cellophane is coated with a dip or spray application using a plasticizer or alcohol as the solvent.

The chief problem in the addition of antioxidants to packaging materials is the loss of antioxidants due to volatilization and steam distillation. We have found that under commercial conditions as much as 90% of the antioxidant can be lost during the application. This loss is reduced to a minimum when applying the antioxidant in wax or when no water is present.

Certain fluorochemicals repel oil and grease when incorporated into the

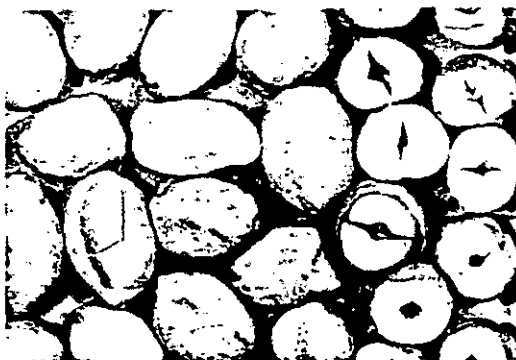


FIG. 85. CRACKED OIL ROASTED PEANUTS

Peanuts roasted with high moisture may crack and become hard.

(2) Hardness and toughness is slightly related to variety of peanuts with Spanish being hardest and Virginia being least.

(3) Close grading or hand picking to remove shriveled kernels practically eliminates all hard peanuts.

(4) Plump kernels made products of superior aroma, color, flavor, and texture, while those that are shriveled have hard or tough texture, musty aroma and sweet, musty, irritating flavor.

(5) Blanching and oil or dry roasting significantly reduce hardness and related undesirable qualities in peanuts.

(6) Chemical analyses showed plump kernels are softer with more oil, less moisture, and lower in sugars, free-fatty acids, and peroxide values than shriveled kernels.

(7) Hardness and toughness increase and sensory scores on flavor are decreased by rapid drying at temperatures above 110°F.

(8) Hard peanuts are more difficult to blanch, roast, and grind into peanut butter; and the butter is stiffer with less tendency toward oil separation.

(9) Hardness is associated with high moisture in the kernels at the time of roasting.

(10) Freezing peanuts before curing causes peanuts to become very hard with a disagreeable acrid flavor.

(11) All varieties dried at 70°F. with rapidly circulating air have very low percentages of hard peanuts, and the flavor was very good.

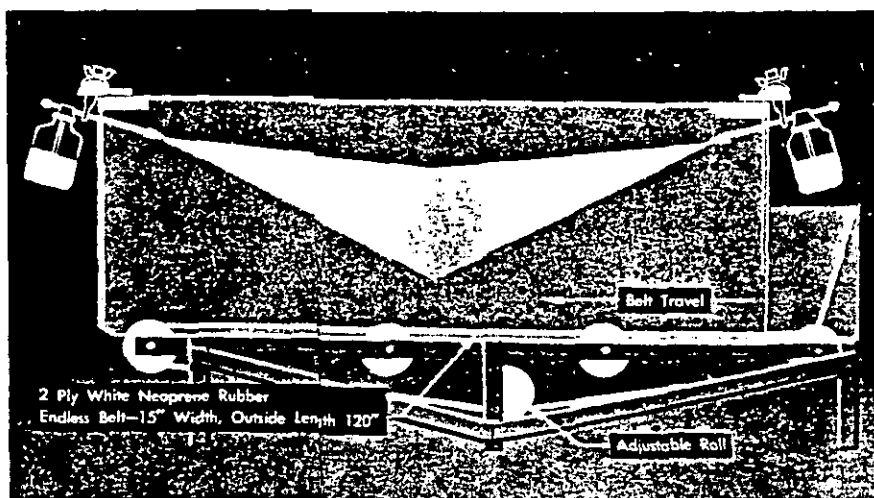
Factors associated with hard peanuts may be summarized as follows: (1) rapid drying at too high temperature; (2) roasting peanuts which are not well dried; (3) sun damage during curing; and (4) freezing damage during early stages of field curing while the nuts are still high in moisture. At harvest, unshelled peanuts usually contain 35 to 40% moisture and have a freezing point of 24° to 28°F.

materially increase the shelf-life of salted peanuts. The total result is increasing the shelf-life as much as 137% by the use of antioxidants.

The spray technique may be continuous or on batches of nuts. For continuous operation a dilute form of BHA (Tenox 4) is sprayed directly onto a continuous belt containing raw peanuts which are to be cooked immediately. A transparent spray hood is erected over a section of the conveyor belt. One or more atomizing-type spray nozzles are placed in the hood in such a manner that a fine mist will completely fill the hood when compressed air is applied to the nozzles. The amount of antioxidant applied to the nuts can be varied by adjusting the concentration of the antioxidant solution, by regulating the speed of the conveyor belt, and by controlling the amount of air pressure applied to the spray nozzles. The shelf-life of roasted peanuts has been extended four times by this treatment.

For batch operations the antioxidant is applied from spray nozzles similar to that described above. A definite amount of antioxidant is sprayed onto each batch of peanuts. Types of nuts and treatments which they receive before the antioxidant is applied will have a marked effect on the final stability of the nuts against flavor changes.

A process for coating peanuts and other nuts with distilled monoglyceride and an antioxidant is reported to add at least 12 months to the shelf-life. The coating amounts to 3 to 5% by weight of the nuts. The antioxidant level is controlled on the nut surface to 10 ppm. Molds and yeast are limited to 100/gm. and total bacteria count is reduced by 80% (Anon. 1965B).



Courtesy Tennessee Eastman Corp.

FIG. 82. APPLYING ANTIOXIDANT TO PEANUTS

A transparent hood is placed above a conveyor belt on which peanuts are carried to the roaster. A fog of antioxidant is maintained under the hood by nozzles spraying antioxidant into the nuts.

Physical Properties						
Tyler	On 35	On 48	On 65	On 80	On 100	Thru 100
U.S.S. equiv.	On 40	On 50	On 70	On 80	On 100	Thru 100
Minimum	0.0	7.5	37.5	14.5	15.5	2.8
Average	0.6	11.7	43.4	17.3	20.0	7.0
Maximum	1.3	15.9	49.1	20.0	24.4	11.3
Apparent density	0.833					
Rate of solubility (Dunn method)	7.6 sec.					
Caking resistance	4 mos. to 1 year					
Crystals per pound	54,000,000					
Specific surface (sq. ft./lb.)	64.1					

Peanuts may absorb insecticides and show up after salting. Gilpin *et al.* (1953) found musty off-flavors in unroasted, roasted, and salted peanuts grown in soil in which technical benzene hexachloride at a dosage rate to give 1 lb. gamma isomer per acre or in lindane, 1 lb. per acre, applied with the fertilizer, were used as insecticides. The former chemical gave slightly stronger off-flavor; however, in both cases the eating quality was impaired.

When peanuts were grown using 4 lb. aldrin, 2 lb. dieldrin, or 25 lb. toxaphene per acre as soil treatments or 2% aldrin or dieldrin dust on the foliage of peanut plants, there was no off-flavor in the peanuts.

Potatoes French fried in oil made from peanuts grown on soil treated with technical benzene hexachloride had slightly more off-flavor than potatoes fried in oil from peanuts grown in untreated plots.

Use of Antioxidants

A synergistic antioxidant containing propyl gallate and citric acid, dissolved in propylene glycol and then mixed with salt, was reported to increase the shelf-life of deep-fat fried peanuts from 50 to 200% by Hall and Sair (1950).

There are many antioxidants which may extend the shelf-life of salted peanuts. A distinction should be drawn between true antioxidants and synergists or metal deactivators (Stuckey 1956). In most cases, true antioxidants are phenolic in nature, but may be derived from natural or synthetic sources. In contrast, synergists or metal deactivators are normally acids or salts of ascorbic, citric, tartaric, or phosphoric acid.

Antioxidants approved for food use in the United States include gum guaiac, various tocopherols, lecithin, propyl gallate, butylated hydroxyanisole (BHA), and butylated hydroxytoluene (BHT).

The higher gallates (ethyl, octyl, and in some cases, dodecyl) are permitted in Europe, being used quite extensively in some of the North Sea countries. But in the United States the most important antioxidants for fats and oils are BHA, BHT, and propyl gallate. Most commercial formu-



Courtesy Preedit Electric Roaster Co.

FIG. 80. SMALL ROASTER FOR INSHELL PEANUTS

This electric, time-controlled, infrared heated, unit roasts 12 lb. of inshell peanuts in 20 min. The belt-driven, oscillating cylinder is stainless steel and rotates on ball bearings, with a total weight of 96 lb.

The type of salt used is important. It is much more difficult to hold fine granulated salt on the surface of the nuts than is the case with a flake salt. The little cubes of the former have much less surface and the binding action depends on a high amount of surface. The best salt for peanuts is composed practically 100% of flakes fastened together in odd shapes.

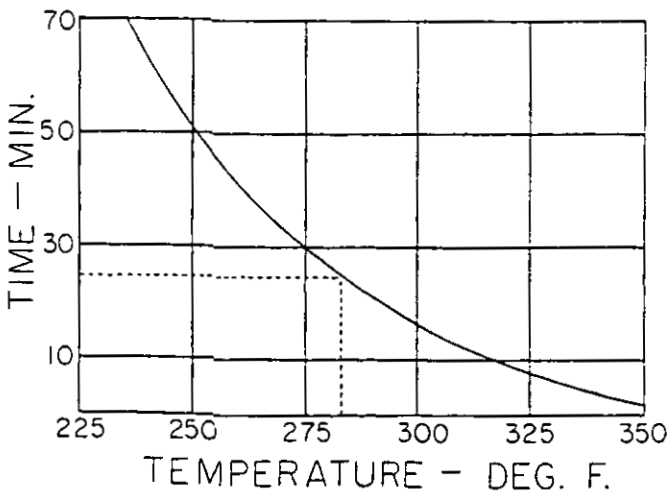


FIG. 81. TIME TEMPERATURE RELATION OF ROASTING PEANUTS IN OIL

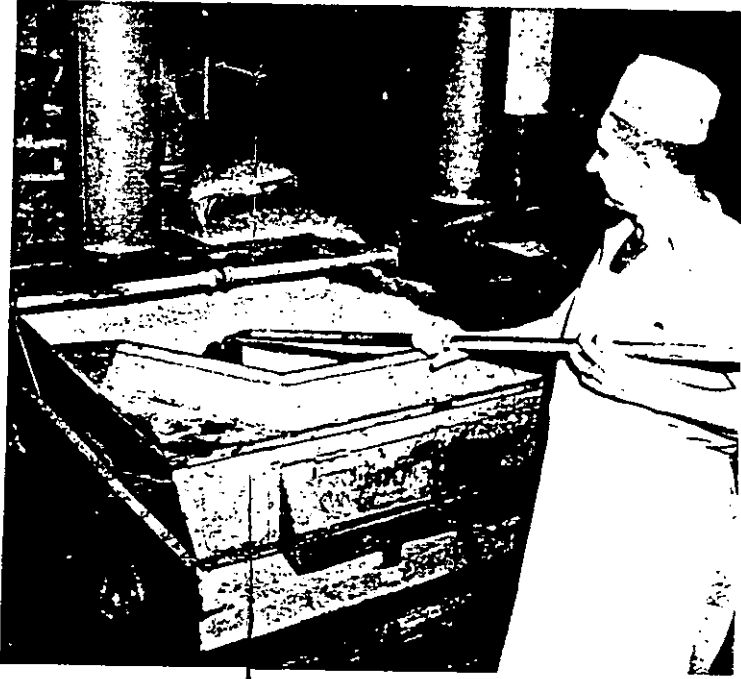
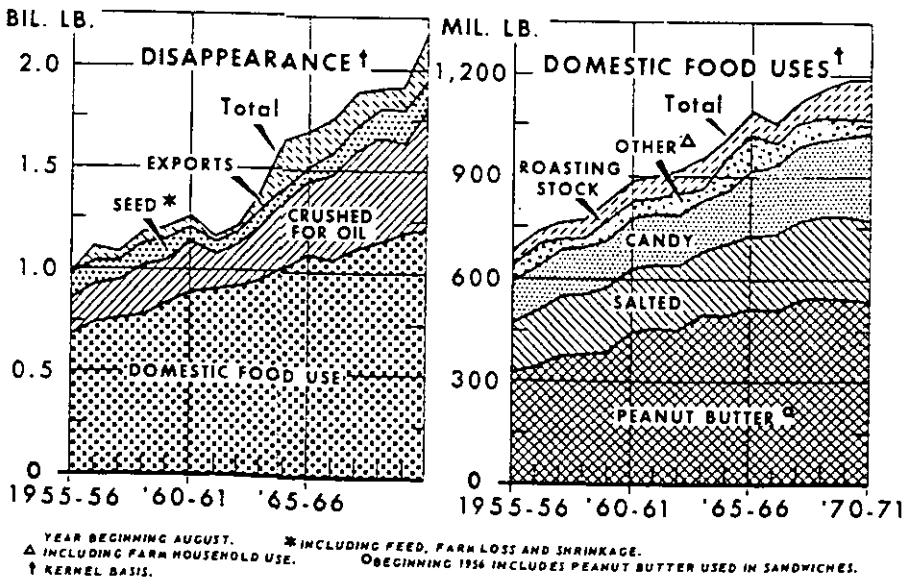


FIG. 78. BATCH PEANUTS IN OIL FOR SALTING

PEANUT DISAPPEARANCE AND FOOD USES



Courtesy of U.S. Dept. of Agr.

FIG. 79. PEANUT DISAPPEARANCE AND FOOD USES



Courtesy Gromax, Inc.

FIG. 77. BATTERIES OF PEANUT SELECTORS IN OPERATION

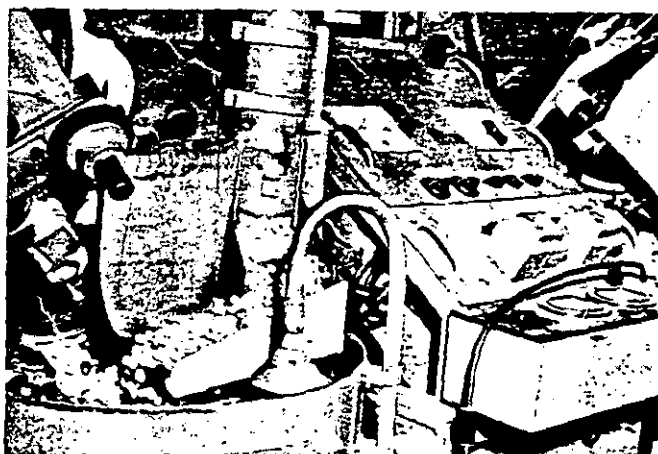
Smaller or larger kernels of each of the above varieties may be had by screening. However, smaller ones are usually immature, shriveled, contain more dirt in the wrinkles, are more likely to mold, are lacking in flavor, are difficult to blanch, and usually have a hard texture. The size of kernels is larger in years or locations with favorable growing conditions.

A highly accurate electronic unit that counts at the rate of 250 to 750 seeds per min., depending on the size and uniformity, was developed. A weighed test sample is poured into the open top of the unit. Vibration causes the peanuts to travel in a single file along a spiral track. When discharged onto a chute, the peanuts break a beam of light as they go down. Interruption of the light beam is detected by a photocell which produced an electrical pulse. Pulse is amplified by a transistorized amplifier to operate a high-speed count register. The counter registers the total count for each sample and is reset to zero for next sample by push button (Anon. 1962).

COATING AND SALTING PEANUTS

It was early believed that salt ruins oil and that it takes only a few grains to reduce the life of cooking oil. Another belief was that if nuts were roasted slowly they became hard, and that fast cooling produced undesirable flavor.

Keating (1940) used mineral oil for glazing peanuts for appearance. Nuts were removed from the roaster and approximately one-half per cent of their weight of salt was added. The nuts were about half cooled then glazed with mineral oil and then three-fourths per cent more salt is added.



U.S. Dept. Agr. Photograph

FIG. 75. ELECTRIC EYE SORTER

The kernels which have not been blanched are automatically removed.

seed beyond the normal drop pattern and it falls into a "reject" chute. Electronic scanning of each seed from several angles means that the kernels must pass photo-cells in single file. This is accomplished by feeding them into a constant-speed grooved belt which carries them toward the "examination chamber" in a constant-rate single-file flow. The incessant accepting/rejecting process takes place as the seed falls through the scanning chamber, and is accomplished so gently damage to the seed is impossible.

This new electric eye method of inspection has the advantages of (1) making uniform decisions quickly, (2) inspecting all sides of the seed for greater product perfection, and (3) working 24 hours per day without "changing shifts" or costly extra time. Sensitive safeguards in the machine cut it off automatically if an illumination lamp goes out or air supply fails. Manufacturers claim one man can attend up to 50 machines!

A typical installation has rows of the machines arranged side-by-side in a compact battery. All machines are "programmed" to meet carefully selected quality-color standards; and the good seeds and the rejects feed single-file onto separate, continuous belts.

PEANUT COUNTS PER POUNDS

In certain products the peanuts are counted. This is true with peanuts in salted nuts, in certain candy clusters, candy bars, cookies, cereals, and other products. Whole small peanuts may be preferred to whole large kernels or pieces; thus, there is a demand for grades or varieties with a

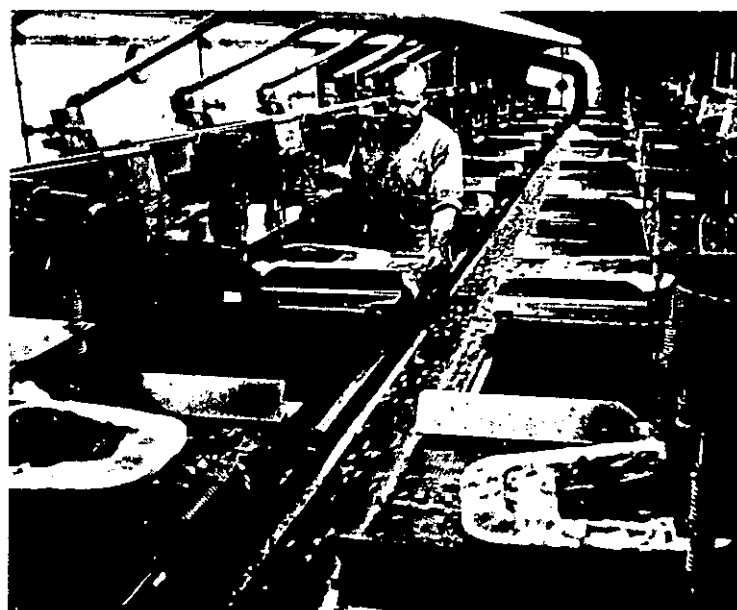
fa
m.



Courtesy Seabrook Blanching Corp.

FIG. 71. CHECKING QUALITY OF INCOMING PEANUTS

Quality control includes checking moisture, per cent splits, and coloration, at hourly intervals in this water blanching station.



Courtesy Seabrook Blanching Corp.

FIG. 72. INTERIOR VIEW OF WATER BLANCHING PEANUT PLANT

skins are rubbed off and blown into porous bags, and the hearts are separated from the cotyledons by screening.

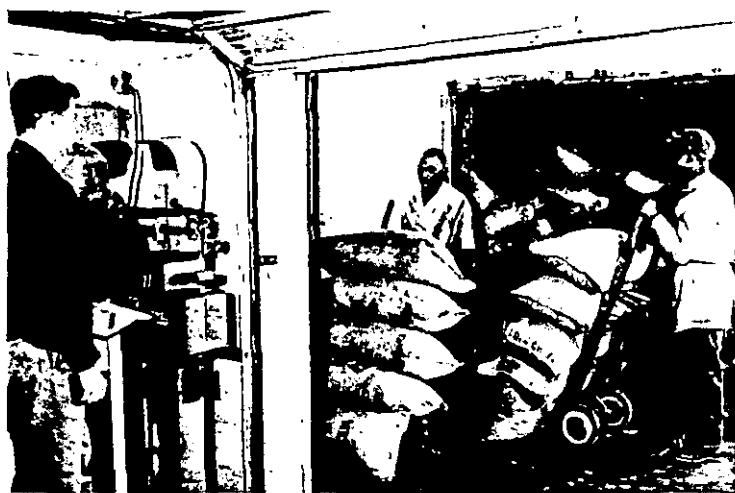
During heating and blanching there is a loss of about 12% in weight, 5% skins, 4% hearts, and at least 3% moisture. For certain products it is desired to remove the skins without splitting the kernels, in which case the hearts are retained.

Split nut blanchers employ rubber elements. The red skins are removed without excessive brushing or rubbing and the blanched nuts are delivered free of meal. Triple aspiration keeps small nut fragments or hearts from being discharged with the skins and chaff. A magnet built into the feeder traps foreign iron or steel objects.

Whole nut blanchers have resilient rubber rolls which insure minimum splitting and scratching. This unit is used for nuts to be salted or used in confections.

X Water Blanching

Water blanching is a relatively new patented process that became a reality in 1949. It has the advantage that the kernels are not heated to destroy natural antioxidants, but has the disadvantage that drying is necessary and the hearts are retained. The first step is to cut the skins of the individual kernels longitudinally. This is done by rolling the kernels between sharp stationary blades and slitting the skins on opposite sides. The kernels are then run through hot water sprays to loosen the skins, and



Courtesy Seabrook Blanching Corp.

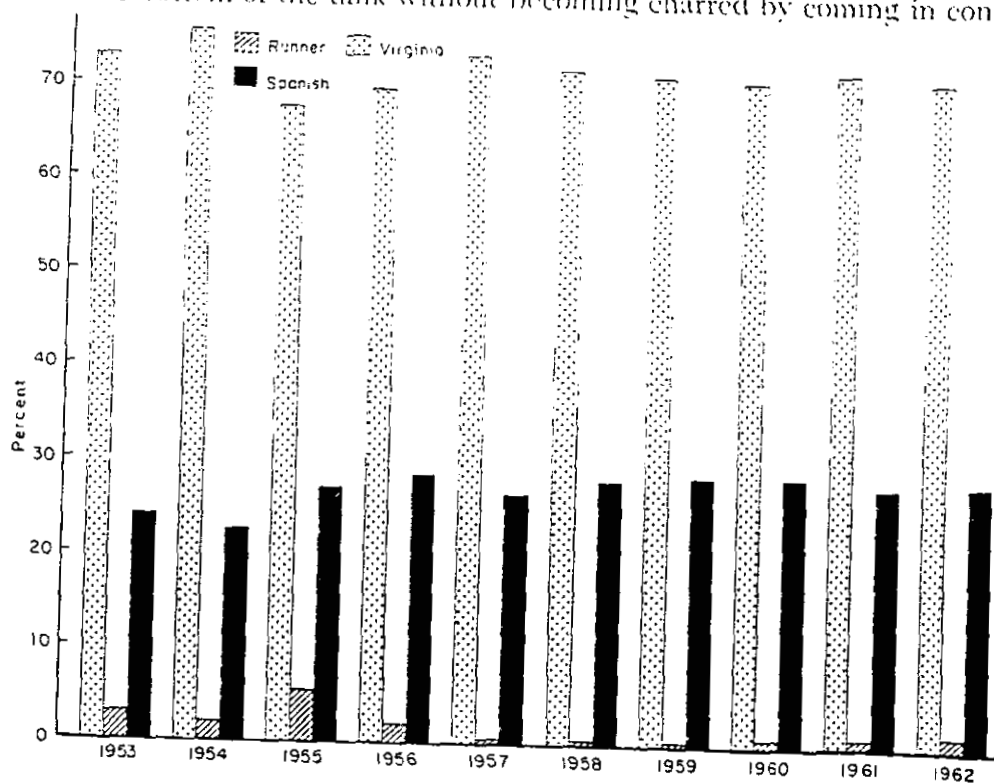
FIG. 69. CHECKING-IN LOAD OF PEANUTS AT WATER BLANCHING PLANT

All loads are weighed, sampled and results reported to customer.
Minimum truck loads are 30,000 lb.

They may then be air-cooled by a turbine blowing over the nuts on the conveyor belt, and salted by passing under a double-plate shaker type salt-er that applies 1.8 to 2.2% salt to the nuts. They then pass under a "shine oil" applicator and on to a mixer. The latter is a double set of rotating broad fingers which mix the kernels on the belt to equalize the salt which has already been oiled on. From the mixer the peanuts are bagged with a moisture content of about 1.25%.

In order to oil roast peanuts of uniform quality in batches, the oil must be continuously filtered, blended, and adjusted to volume, as well as physical and chemical characteristics. Furthermore, the temperature and time of roasting should be as constant as possible. This is especially difficult in batch roasting when cool peanuts are added to hot oil. To overcome this, the same quantity of peanuts should be added to the same quantity of oil at the beginning of each batch. Continuous oil roasters are practically automatic in that the oil level, oil temperature, flow of peanuts, and oil filtration are constant. Batch roasters have an advantage in that one or more roasters may be cut off when not needed.

The heating elements in the oil roaster should be on the sides of the tank rather than in the bottom. This allows the "meal" that accumulates to settle to the bottom of the tank without becoming charred by coming in con-



Courtesy K. E. Ford

FIG. 68. DISTRIBUTION OF PEANUTS FOR SALTING BY TYPES AND YEARS

Salted Peanuts

INTRODUCTION

Second to peanut butter, the largest amount of edible peanuts are salted. Among the peanut eating peoples of the world, salting is the preferred way of eating them. The term salted peanuts refers to peanuts that are shelled, roasted, and salted to taste. While usually eaten directly from the container, they may be used in candies, salads, desserts, and other ways.

During the 1950-1970 period, salted peanuts increased from 200 million pounds (farmers stock basis) to over 300 million pounds. The gain was about equal to the population growth, so the per capita consumption remained about $1\frac{1}{2}$ pounds.

Salted peanuts are packed in retail sizes of transparent film bags or hermetically sealed in cans. Salters pack a small quantity of salted peanuts in bulk for repackaging or for selling through vending machines. Since about 1965, the industry has marketed dry-roasted salted peanuts to appeal to calorie-conscious consumers. Because these peanuts do not have the added oil which is picked up by the kernel during oil roasting, distributors have promoted sales on their lower calorie content.

(Roasting, parching, or toasting refers to rapid cooking with radiant heat or cooking by surrounding the peanuts with a hot medium, which may be oil. Peanuts may be roasted in hot sand, ashes, or embers.) About 72% are Virginias, 25% Spanish, and 3% are Runners. Varieties of peanuts for salting vary from small Spanish to jumbo Spanish, with a preference for medium-size Runners. There is no consistent relationship between size or variety of peanuts and quality of salted peanuts. Salters usually purchase peanuts from brokers as needed.

The typical flavor of roasted peanuts is developed during this process. Pickett and Holley (1952) showed that mixtures of amino acids and carbohydrates reacted to produce tetrahydrofuran derivatives along with noticeable browning and desirable aromas. The major gaseous component was carbon dioxide, with traces of ammonia, hydrogen sulfide, and dimethyl. Mason and Waller (1964) believed that flavor originates from specific types of micromolecules rather than from general, macromolecular cellular components such as the large globulin proteins and the starch.

Approximately 200 million pounds of raw peanuts are salted by 169 firms in 32 states of this country. States leading in firms which salt peanuts are Ohio, Texas, Pennsylvania, Illinois, and California. The fall months

some other AVI books

- Arbuckle*
Amerine, Berg and Cruess
Brink and Kritchevsky
Charm
Deman and Melnychyn
Desrosier
Goldblith and Joslyn
Graham
Greig
Griffin and Sacharow
Guthrie
Hall, Farrall and Rippen
Hall and Hedrick
Harris and Von Loesecke
Henderson
Inglett
Inglett
Joslyn and Heid
Junk and Pancoast
Levie
Margen
Matz
Matz
Matz
Pederson
Pomeranz and Meloan
Pomeranz and Shellenberger
Potter
Reed and Peppler
Sacharow and Griffin
Schultz
Schultz and Anglemier
Schultz, Cain and Wrolstad
Schultz, Day and Libbey
Schultz, Day and Sinnhuber
Smith and Circle
Stadelman and Cotterill
Tressler and Joslyn
Tressler, Van Arsdell and Copley
Webb and Johnson
Webb and Whittier
Weiser, Mountney and Gould
Weiss
Woodroof
Woodroof
Woolrich and Hallowell
- ICE CREAM, 2ND EDITION
 TECHNOLOGY OF WINE MAKING, 3RD EDITION
 DAIRY LIPIDS AND LIPID METABOLISM
 FUNDAMENTALS OF FOOD ENGINEERING, 2ND EDITION
 SYMPOSIUM: PHOSPHATES IN FOOD PROCESSING
 THE TECHNOLOGY OF FOOD PRESERVATION, 3RD EDITION
 MILESTONES IN NUTRITION
 SAFETY OF FOODS
 ECONOMICS OF FOOD PROCESSING
 PRINCIPLES OF PACKAGE DEVELOPMENT
 FOOD SANITATION
 ENCYCLOPEDIA OF FOOD ENGINEERING
 DRYING OF MILK AND MILK PRODUCTS
 NUTRITIONAL EVALUATION OF FOOD PROCESSING
 FLUID-MILK INDUSTRY, 3RD EDITION
 CORN: CULTURE, PROCESSING, PRODUCTS
 SYMPOSIUM: SEED PROTEINS
 FOOD PROCESSING OPERATIONS, VOLS. 1, 2, AND 3
 HANDBOOK OF SUGARS
 MEAT HANDBOOK, 3RD EDITION
 PROGRESS IN HUMAN NUTRITION
 BAKERY TECHNOLOGY AND ENGINEERING, 2ND EDITION
 CEREAL TECHNOLOGY
 CEREAL SCIENCE
 MICROBIOLOGY OF FOOD FERMENTATIONS
 FOOD ANALYSIS: THEORY AND PRACTICE
 BREAD SCIENCE AND TECHNOLOGY
 FOOD SCIENCE
 YEAST TECHNOLOGY
 FOOD PACKAGING
 FOOD ENZYMES
 PROTEINS AND THEIR REACTIONS
 CARBOHYDRATES AND THEIR ROLES
 CHEMISTRY AND PHYSIOLOGY OF FLAVORS
 LIPIDS AND THEIR OXIDATION
 SOYBEANS: CHEMISTRY AND TECHNOLOGY, VOL. 1
 EGG SCIENCE AND TECHNOLOGY
 FRUIT AND VEGETABLE JUICE PROCESSING, 2ND EDITION
 FREEZING PRESERVATION OF FOODS, 4TH EDITION, VOLS. 1, 2, 3 AND 4
 FUNDAMENTALS OF DAIRY CHEMISTRY
 BYPRODUCTS FROM MILK, 2ND EDITION
 PRACTICAL FOOD MICROBIOLOGY AND TECHNOLOGY, 2ND EDITION
 FOOD OILS AND THEIR USES
 COCONUTS: PRODUCTION, PROCESSING, PRODUCTS
 TREE NUTS: PRODUCTION, PROCESSING, PRODUCTS VOLS. 1 AND 2
 COLD AND FREEZER STORAGE MANUAL