Chapter 15

Peanut Curing and Post-Harvest Physiology

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Introduction

When removed from the soil at harvest, peanuts usually have a moisture content in excess of 40 percent (wet basis) and vary widely in physiological maturity. Although they may partially dry in the field, mechanized harvesting operations usually require that peanuts be harvested at high moisture contents in order to avoid the risk of high field losses and weather damage. At these moisture contents many physiological processes are operative. The term "curing" is used to connotate physical and biochemical changes in addition to the moisture loss that occurs during preservation by drying.

It is desirable to cure peanuts in a manner to preserve or enhance their quality. Little is known about changes which occur in peanuts during curing, the effect of curing treatment on these changes, or how they affect peanut quality. Very few measurements for peanut quality have received general acceptance. Peanut curing treatments are usually recommended that have been shown to produce kernels which do not skin or split excessively during shelling and which have an acceptable flavor. Other possible measurements of peanut quality will be discussed later.

Peanuts must be cured to 10% moisture or less for marketing and safe storage (26). They are normally cured in large containers, such as bins or trailers with perforated

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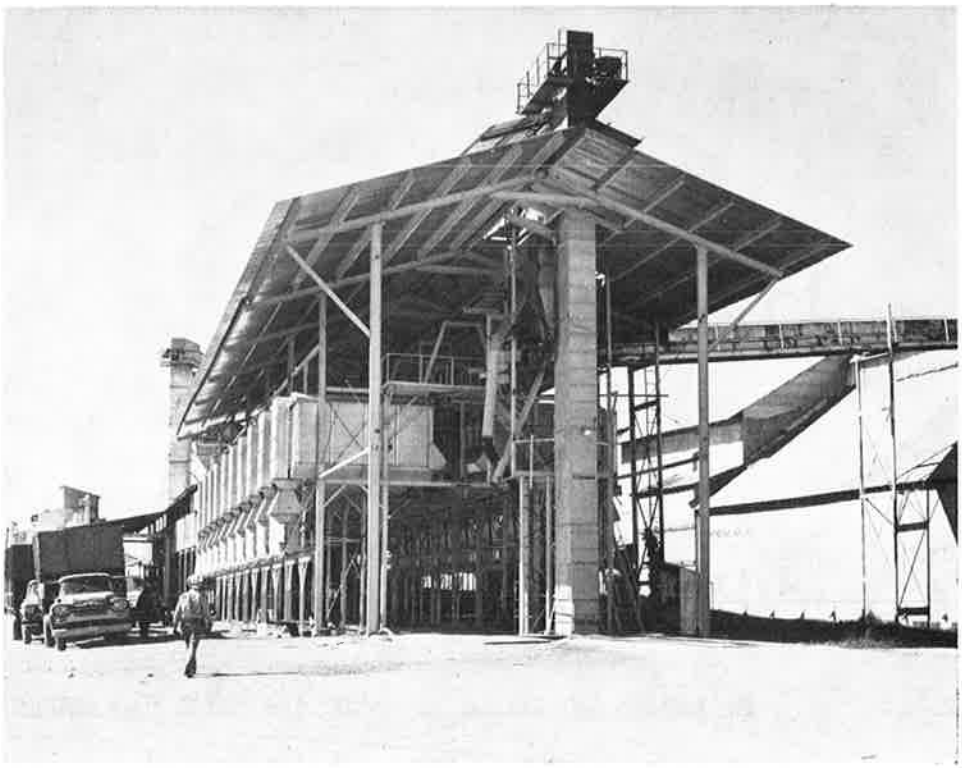

Figure 1. A large commercial installation for curing peanuts.

floors, by forced heated or unheated air. This method of mechanical curing allows control over the curing process. Curing must proceed rapidly enough to prevent molding, souring or other forms of deterioration but not so rapidly at to lower the quality of the peanuts. The peanuts should be dried uniformly and the final moisture content should be low enough to insure safe storage but not so low that handling and shelling operations will cause excessive kernel damage. Proper management of suitable facilities will consistently cure peanuts which compare favorably with those subjected to the vagaries of weather in field curing methods.

A large percentage of the peanuts produced for seed in the Virginia-Carolina and the Southwestern peanut-producing areas of the United States are field cured on stackpoles or in bags. Recent research indicates that high quality seed peanuts can also be produced by mechanized curing (49). These results coupled with the increasing scarcity and cost of labor probably will cause field curing to be discontinued in the near future.

This chapter describes the mechanized curing process, reviews research on postharvest physiology of peanuts and discusses the interaction of these factors in relation to peanut quality.

The Drying Process

The direction and rate of moisture transfer between peanuts and the surrounding air are dependent upon the vapor pressure gradient between the two mediums. Factors which affect the rate of drying include temperature, moisture content, moisture distri-

bution, equilibrium moisture content and diffusivity of the peanuts; and the temperature, relative humidity (RH) and velocity of the air surrounding the peanuts (18).

The drying potential of the curing air is increased by heating. The air heats the peanuts increasing the vapor pressure of the moisture within them so that drying takes place more rapidly. Attempts have been made to apply heat energy directly to peanuts by radiant heating, dielectric heating, and conduction heating in conjunction with high vacuum (43, 48). Various methods of convection heating have been tried in connection with tumbling, thin-layer conveying, drying towers, and other schemes to present the peanuts to the convected heat (5, 6). Probably because of damage to the peanuts by excessive handling, other types of quality deterioration, or economic considerations, convection heating by forcing heated air through a stationary mass or batch of peanuts is the most generally accepted method for peanut curing. This method is often called "bulk curing".

The equilibrium moisture properties of materials are important in drying. Virginia, runner and Spanish peanuts have been found to have similar equilibrium moisture contents (6, 24). Peanut kernels at the maximum marketable moisture content of 10% (wet basis) are in equilibrium with air at approximately 85% RH and 32°C. Therefore, the drying potential of the air used for curing must be greater than provided by these conditions. Low relative humidities are desirable to speed the drying process, but care must be exercised to avoid overdrying the peanuts once they are cured. For example, a curing regime of 50% RH 32°C would dry the kernels to 5% moisture if the peanuts were left under these conditions for an extended period of time. Present marketing procedures specify 8% moisture in peanut kernels. If the moisture is above this level a deduction is made for the weight of excess moisture, but if the moisture is below 8% no allowance is made. Therefore, overdrying penalizes the grower both in reduced product weight and increased drying costs.

During the drying process peanut kernels are encased in the hulls. The hulls dry before the kernels and moisture from the kernels passes through the hulls to be carried away by the air. Since the hulls are more hygroscopic than the kernels, moisture will move from the kernels to the hulls even when the hulls contain a higher moisture percentage than the kernels (6, 24). During bulk curing with heated air a considerable potential for moisture transfer from kernel to hull exists throughout most of the process. When the kernels reach the desired final moisture content and the peanuts are removed from the dryer, moisture will continue to move from the kernels into the hulls until a moisture balance is established. If there is no moisture exchange between the mass of peanuts and the surrounding air, the extent to which the moisture content of kernels and hulls will change depends on the initial difference in moisture content and the relative weights of the two materials. Data and equations have been published to describe this process (6).

For deep-layer drying, air is normally forced upward through the layer of peanuts and, during the initial stages of drying, is usually saturated before it emerges from the top of the layer. Since this saturated air does no drying, the layer of peanuts is not being dried uniformly or simultaneously from bottom to top. Instead, a zone exists in which all of the drying takes place at any given time. This zone expands and moves upward as drying progresses and at completion includes the entire layer unless equilibrium has been established in the lower region.

Initial moisture content of the peanuts, drying potential of the air and rate of air flow determine the movement of the drying front and the configuration of the

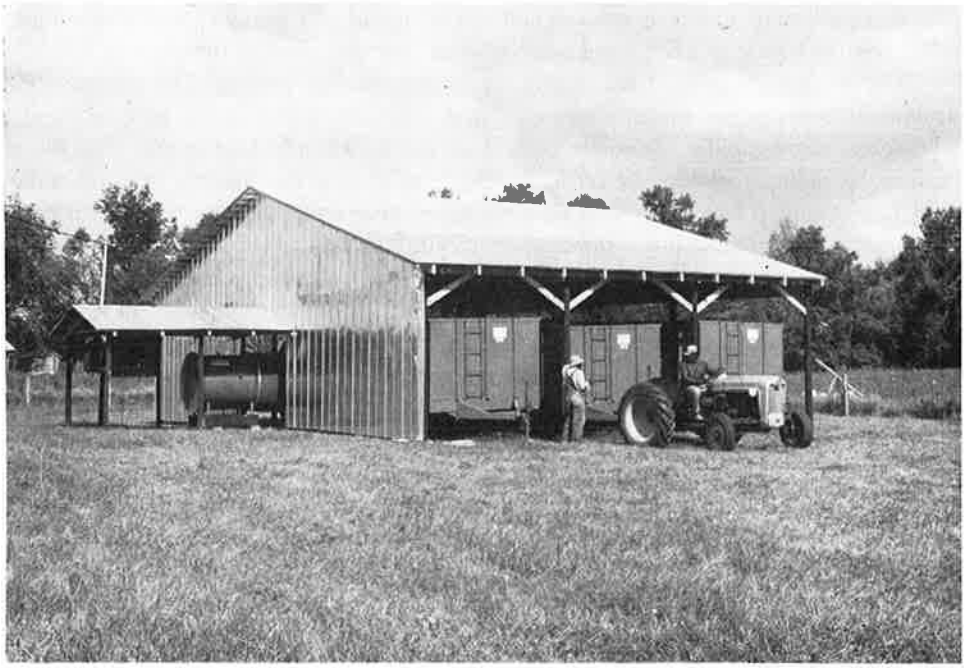

Figure 2. A small farm dryer for peanuts using trailers with plenums underneath.

drying zone in a layer of peanuts. For a given set of conditions the rate of movement of the drying front varies inversely with the initial moisture content and directly with the drying potential of the air and the rate of air flow. The differential in moisture content across the drying zone varies directly with the initial moisture content of the peanuts and drying potential of the air. The width of the drying zone varies directly with the rate of air flow and the drying potential of the air, and inversely with initial moisture content of the peanuts.

It is necessary to insure that drying is accomplished quickly enough to prevent spoilage of those peanuts which dry last. To avoid overdrying the peanuts adjacent to the air intake the final moisture-content differential across the layer should be kept within 2-3% (4, 6). In order to achieve these goals a suitable balance between depth of the layer, initial moisture content of the peanuts, drying potential of the air and rate of air flow through the layer must be maintained. Generally the drying potential of the air is regulated by limits on temperature, the rate of air flow is determined by economic considerations, and the depth of the layer is varied according to the initial moisture content of the peanuts.

As will be discussed later, the milling quality of peanuts is lowered by too rapid drying. This problem is related directly to the drying rate of individual peanut kernels and only indirectly to the average rate of drying of the entire layer. Increasing the temperature of the drying air increases the rate of drying of individual peanuts, but studies have shown that increasing air flow rates beyond 24 cubic feet per minute (cfm) per square foot of layer has very little effect on the rate of drying of peanuts within a thin layer (6). High air flow rates were found desirable in bulk curing to expand the drying zone and minimize final moisture content differentials across the layer of peanuts, but there is a practical limit on the amount of air flow provided since high

air flows cause inefficient drying by increasing frictional losses and discharging unsaturated air. These losses increase expenditures for heat, fans, and power.

Because of its importance to proper bulk curing, a quick convenient and reasonably accurate method for determining air-flow rate through layers of peanuts is desirable. Static pressure required to force air through a layer of peanuts is proportional to the rate of air flow. Measurement of the total drop in static pressure across layers of peanuts has been suggested as a practical method to estimate this rate of air flow (6). Moisture content was found to have little or no effect on the resistance of peanuts to air flow, but the presence of foreign material (sticks, dirt and trash) increased the resistance. For clean peanuts the pressure required for recommended air flows averaged about ½-inch of water excluding losses in ducts, perforated floors and other passages. More precise estimates of air flow through peanuts are sometimes desired where it is not possible to measure air velocity in ducts. In this regard, a special device has been developed for measuring the flow-rate of air emerging from the surface of layers of peanuts or other porous material. (7).

Curing Procedures and Equipment

As mentioned previously, bulk curing has been generally accepted as a practical, economical and convenient system for peanut curing. Moderate curing rates at low temperatures and minimum damage from handling can be accommodated economically in deep-layer batch drying. The interrelationship previously discussed among depth of layer, initial moisture content of the peanuts, rate of air flow, and drying potential of the air is of critical importance.

Several sources of recommendations for bulk curing peanuts are available through the Agricultural Extension Services of the peanut-producing states. Some of these recommendations are as follows: (a) the curing air temperature should not exceed the lesser of 35-38°C or 10°C above ambient, (b) the minimum air-flow rate should be 10 cfm per cubic foot of peanuts or 2 cfm per pound of moisture to be removed, (c) the practical depth limitation for a layer is 4-5 feet for peanuts containing 30% moisture, (d) no portion of the drying layer should be dried to less than 7% moisture, (e) drying should be stopped when the average moisture content of the peanuts is between 8 and 10%.

Since most curing systems add heat at a constant rate to outside air, which is forced through the peanuts, the drying potential of the curing air is not controlled precisely. Use of a humidistat set for the addition of heat only when the outside relative humidity exceeds 65 or 70 percent has been proposed (6). Attempts to control the relative humidity of the curing air by using a humidistat in the heated air stream in conjunction with an off-on-type heater have not proven satisfactory although a proportioning-type control might allow this type of installation.

It is generally recognized that the drying system should provide uniform air flow at all points across the drying layer. Removal of dirt and other foreign material and uniform distribution of the peanuts within the curing unit are necessary to avoid areas which do not dry properly and are thus subject to mold or other damage.

A variety of bulk curing facilities are used for curing peanuts. Farm-constructed bins, metal grain bins, specially designed commercial curing structures (Figure 1), and trucks, wagons, or trailers with perforated floors over plenums (Figure 2) are in use. Most of them are batch-type and employe one-way air flow, but some systems have provisions for reversing the direction of air flow through the layer of peanuts to

reduce the moisture-content differential across the layer. Several companies manufacture dryers, air-distribution equipment, dryer wagons, and accessories for curing peanuts and some companies design and erect peanut-curing facilities that provide special cleaning and handling equipment. In some areas peanut curing is done mostly by commercial or custom facilities while in others on-farm curing predominates. Moving peanuts into and out of dryers causes damage and requires additional labor during a period when labor supply is critical for many growers. Handling should be mechanized or eliminated by use of dryer trailers or similar equipment if possible.

Effects on Physical Properties

The undesirable tendency of peanuts to split and skin during the shelling operation has gained considerable notice since the introduction and rapid acceptance of mechanical harvesting and curing methods. Although some of these problems are caused by harvesting (13, 46), they are influenced greatly by the mode of curing (6, 9, 41). In addition, other undesirable effects on kernel size, density, brittleness, and hardness have been reported (6, 36, 44). Studies have shown that rapid drying and overdrying increase the amount of kernel damage caused by subsequent shelling and that addition of moisture to overdried peanuts prior to shelling only partially suppresses this damage (6).

Penetrometer tests on Virginia-type peanuts have shown that the hardness of raw peanuts was not significantly affected by curing temperatures less than 38°C, but that the hardness of peanuts varied inversely with the moisture content of the kernels over the range of 2.6 to 11.0 percent moisture. Oil roasting of peanuts with high moisture contents resulted in peanuts that were much harder than those roasted with lower moisture contents (16).

Results of studies on the physical properties of peanuts indicate that the advantage of increased curing capacity brought about by higher curing temperatures and more rapid drying must be weighed against the reduction in peanut quality which would ensue (6).

Effects on Flavor

Early workers in bulk curing quickly concluded that curing temperatures over 35-38°C had a deleterious effect on quality and flavor (2, 4, 10). Studies on field curing showed that certain field conditions also produced poor quality and flavor defects (1, 3, 8). Bailey and Pickett (1) found that temperatures inside seeds in freshly dug pods exposed to direct sunlight in Georgia during September were above the 49°C reported (3) to produce hard seed, flavor defects, and impaired viability in peanuts during artificial curing. Rapid removal of moisture and curing temperatures above 38°C seemed to be the most important factors associated with the loss of quality and impairment of flavor. A generally accepted maximum of 35-38°C has been recommended for curing peanuts (11, 27, 45).

By drying freshly harvested peanuts at various temperatures Picket (36) found that 49°C was the least satisfactory as far as flavor and aroma were concerned, and observed that this temperature was in the critical range for life processes. The involvement of a life process in curing off-flavor was postulated in 1957 from studies that used oxygen atmospheres during curing (12). Peanuts bulk-cured in an oxygen atmosphere gave better flavored products than those cured in nitrogen or carbon di-

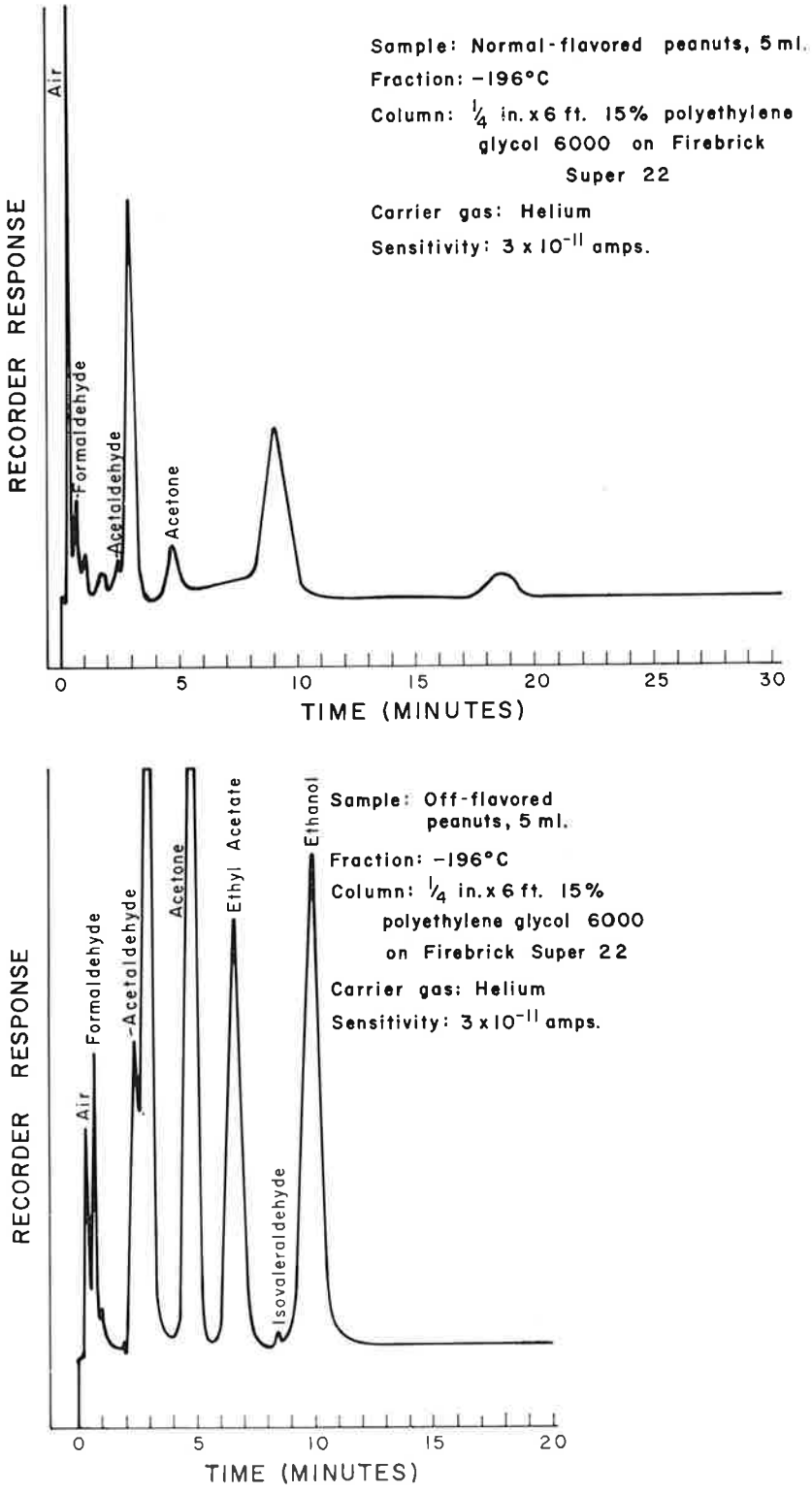

Figure 3. Typical chromatograms of −196°C fraction from normal and off-flavored peanuts.

oxide atmospheres (13). These results suggested that anaerobic respiration was the cause of curing off-flavor. Under slow-curing conditions sufficient oxygen could diffuse into the kernels to supply metabolic demands, but under high curing temperatures the oxygen could not diffuse in at a rate sufficient to supply the increased metabolic demands and consequently an anaerobic condition occurred with a resultant production of off-flavor.

Studies by Whitaker and Dickens (47) indicated that the level of off-flavor in peanuts was related to the amount of anaerobic respiration that occured during curing. Their results also showed that immature peanuts cured at 35°C had more off-flavor than mature peanuts cured at 52°C.

Holaday, *et al.* (19) used a taste panel to evaluate samples of peanut butter from a study involving 5 curing methods, 5 temperatures, 3 types of peanuts and 3 stages of maturity. Virginia-type peanuts were found to have a significant response to temperature of curing while the Spanish-type responded to method of curing.

Beasley and Dickens (6) made the following observations regarding off-flavor production in peanuts: (a) Immature peanuts are more severely damaged flavorwise by improper curing treatment than mature peanuts. (b) The degree of off-flavor produced by high temperature is time dependent. At high temperatures, rapid drying results in less off-flavor than slow drying. At low temperature, slow drying seems to produce slightly better flavor than rapid drying. (c) Peanuts at about 25% moisture when subjected to high temperature develop more off-flavor than peanuts at other moisture contents when subjected to high temperature. They also found that a water emulsion of off-flavored peanuts had a slightly lower pH than peanuts with normal flavor. The skins of peanuts cured at high temperature were observed to be light-colored and more pink than those cured at low temperatures.

Singleton, *et al.* (42) studied changes in large-seeded Virginia-type (Variety NC-2) peanuts cured at 22°, 35°, 45°, and 50°C. Their results indicated that the greatest changes in flavor took place between 45° and 50°C. In a similar study Mullin, *et al.* (29) determined the effects of maturity on off-flavor caused by curing at 50°C. They observed an atypical off-flavor in peanuts cured 5 weeks after pegging and that the typical off-flavor was highest about 8 weeks after pegging.

Physiological Responses to Curing

Prior to 1957, one of the main reasons for the sparcity of work on the physiological responses of peanuts to curing treatment was the concept that peanut curing was merely a matter of water removal (2, 37). The importance of physiological changes in peanuts during curing was emphasized by the postulation that anaerobic respiration during high-temperature curing produces off-flavor (12) and the suggestions by Teter (45) that curing involved physiological changes. Teter also expressed the idea of a ripening state in peanuts which occurs after the peanuts are fully developed and non-growing. This change in concept about the curing process ultimately led to investigations to determine the physiological and biochemical changes which take place in the peanut and how these changes affect quality.

Respiration. Early work on respiration was reported by Schenk, who studied respiration in the developing peanut fruit (38) as well as the influence of curing on the respiratory pattern of peanuts (39). He showed that the maximum respiration rate occurred at curing temperatures of about 42°C and that higher temperatures produced lower rates of respiration and coloration changes indicative of cell damage. During curing at

30°C and 40°C, the respiration rate increased for approximately 6 hours and then decreased in an exponential manner during the remainder of the curing period of about 80 hours. At 50°C the rate of respiration increased very rapidly and then decreased rapidly, in a span of about 3 to 5 hours, to a value slightly lower than the initial value, and then decreased in an exponential manner to the end of the treatment period.

In a direct attempt to associate anaerobic respiration with high-temperature-curing off-flavor Whitaker and Dickens (47) studied changes in the respiratory quotient (RQ) for mature and immature peanuts cured at 35° and 52°C. Major changes in RQ values were found for immature peanuts cured at 35° and 52°C, but only minor changes were noted in the mature samples cured at these temperatures. As the immature peanuts dried at 52°C the RQ value decreased until the peanuts reached about 48% moisture content, increased to a maximum of about 1.9 near 25% moisture content and then decreased to about 0.85 near 10% moisture content. The immature sample cured at 35°C had a similar pattern except there was no initial decrease in RQ. The maximum RQ near 25% moisture in immature samples cured at both temperatures is of interest due to the observation of Beasley and Dickens (6) that the maximum amount of off-flavor is also produced in peanuts at approximately this moisture content. The combination of physiological factors responsible for this phenomena is unknown at present.

Lipids. Early work by Bailey, *et al.* (2) found that curing treatments had no effect either on the percentage of oil in peanuts or on free fatty acids and peroxide values for the oil. Later Pickett and Holley (37) showed that neither stage of maturity nor curing treatment had any detectable effect on unsaturation of the oils insofar as iodine number was concerned. However, curing treatment did influence the oxidative stability of oils from Spanish and runner peanuts as determined by an accelerated oxygen test. The oils from peanuts cured at 49°C and above repeatedly developed peroxides more slowly than those cured at lower temperatures.

Mohapatra (28) recently completed a study of the effects of curing time and temperature on the metabolism of radioactive lipids produced from photosynthetically labelled substrates, in peanuts. The changes in total lipid content were similar for 20°C and 50°C except that the changes were more pronounced at 50°C. Changes in the free fatty acid, monoglyceride, diglyceride and triglyceride components of immature peanuts during curing at 50°C were measured. Measurement of the radioactivity levels of these components indicated that both synthesis and degradation of the different components occurred simultaneously. Free fatty acids appeared to be utilized in glyceride formation during the periods of rapid glyceride synthesis and apparently increased during rapid diglyceride degradation near the end of the curing process. Mohapatra suggested that the changes in lipid metabolism may be controlled by the moisture content of the seeds during curing. This study indicates the importance of studying changes in individual components rather than the beginning and end values of the entire lipid fraction.

Other Peanut Constituents. Pickett and Holley (37) studied curing effects on amino acids, water soluble nitrogen, phytin, sugars, lignin, cellulose, uronic acids, and tannins in peanuts and found no differences in these compounds for freshly harvested peanuts and peanuts cured at temperatures up to 43°C. They found that an observed loss of ascorbic acid in cured peanuts could be checked by curing at elevated temperature but that all ascorbic acid was lost from peanuts during storage. Mohapatra (28) studied the effect of curing temperature on photosynthetically labelled ethanol-soluble constituents, namely sugars, organic acids and amino acids. Of the total radioactivity in

this fraction he found that 86% was accounted for by the sugars. He was unable to show any changes resulting from the curing process.

The effect of curing on enzyme activity levels has also been investigated. Pickett and Holley (37) showed that increasing curing temperatures above 49°C progressively inactivated protease and phosphatase. They suggested that because of the denaturing effect of heat on proteins similar effects would probably be found with most of the enzymes present. Johns, *et al.* (23) showed that the activity level of lipoxidase was enhanced by the normal curing process and suggested that this observation might be related to the loss in color of peanut oil during stackpole curing of peanuts.

Pre- and Post-Harvest Effects on Oil Color

The color of peanut oil may vary from bright greenish-yellow to a very pale yellow or clear depending upon maturity and post-harvest treatments. This variation in peanut oil color has led several workers to investigate its possible use as a maturity indicator and to study the changes in coloration due to pre- and post-harvest treatments. Holley and Young (20) who used a methanol-extraction procedure to remove peanut oil and read the color of the centrifugal extracts at 435 nm, showed color loss to be highly correlated with peanut maturity. They also found that slowly-cured peanuts produced lighter colored oil than rapidly-cured peanuts. This observation was true for all peanut varieties tested. Spanish and Valencia showed a higher rate of loss than Virginia and runner peanuts. Beasley and Dickens (8), using Virginia-type Var. NC-2, studied the effects of maturity, ripeness ("ripened"-vines clipped off at the ground level 7 days before harvest and "unripened" - natural growth till harvest), and curing temperature on peanut oil coloration. They concluded that coloration could be correlated to maturity, that the effect of ripeness on coloration was significant in immature but not in mature peanuts, and that curing temperature influences the coloration of the oil. Emery and coworkers (14, 15) suggested the use of peanut-oil color as a maturity index and as a genetic marker of maturity inheritance in peanut breeding. However, they also pointed out that such an index of maturity was subject to variations due to the loss of oil color during curing.

The pigments responsible for oil color were postulated to be carotenes by Sharon (40) and xanthophylls by Kramer and coworkers (25). Pattee and Purcell (31) isolated and identified the carotenoid pigments of peanut oil and showed beta-carotene and lutein to be the major pigments present in oil from immature peanuts. They found that alpha carotene; zeta carotene, zeaxanthin, flavoxanthin, an unidentified carotene, and a 5-8 expoxide carotenoid were also present as minor components. The total carotenoid concentration in oil from fully matured peanuts was insignificant ($<1\mu g$/liter).

Pattee, *et al.* (32) followed the changes in carotenoid and oil contents of the peanut kernel with increasing maturity. They indicated that the decrease in carotenoid concentration of the extracted oil from an average of 10.5 μg/ml to 0.9 μg/ml was due to dilution produced by the rapid increase in oil content of the kernels during maturation. They also suggested that the carotenoids are in areas separated from the oil-containing spherosomes of the peanut kernel. From studies of oil color loss during curing, Pattee, *et al.* (33) suggested that this loss comes by enzyme-degradation processes involving the enzyme lipoxidase which is activated during curing.

Pre- and Post-Harvest Effects on the Volatile Profile

Recently the volatile components of raw peanuts have been considered in the search for methods to measure and evaluate quality. Gas chromatography, which became a widespread analytical tool in the late 1950's and early 1960's has made analysis of volatiles practical. The first work in this area was done by Pattee, *et al.* (30) who isolated 21 and identified 11 volatile compounds from high-temperature-cured off-flavor peanuts. Both qualitative and quantitative differences were shown between the volatile profiles from normal and off-flavored peanuts (Figure 3). When ground, normal-flavored peanuts were mixed with the —196°C fraction from off-flavored peanuts, the flavor of the mixture was characteristic of the off-flavored peanuts, thus indicating that the compounds contributing to off-flavor had been isolated in the —196°C fraction. In a subsequent study Pattee, *et al.* (34) isolated and identified by gas chromatography and mass spectrometry the volatile components of normal-flavored raw peanuts. Pentane, acetaldehyde, methanol, acetone, ethanol and hexanal were reported to be the major components and methyl formate, octane, 2-butanone and pentanal were minor components. They suggested that the characteristic aroma and flavor of raw peanuts arises from a physical interaction of the components isolated and that hexanal forms the backbone of this aroma.

Identification of the compounds which form the volatile profile and flavor of raw peanuts provides a base for other studies concerning the mechanisms by which these compounds are produced. By following changes in the volatile profile and activity levels of alcohol dehydrogenase and lipoxidase during maturation a relationship between the enzymes and their substrates and products, acetaldehyde, ethanol, pentane, and hexanal was postulated (35).

Mullin, *et al.* (29) used volatile profile measurements and taste-panel analysis to study the effects of maturity on off-flavor development in peanuts cured at high temperatures. Peanuts cured 5 weeks after pegging had an atypical type of high-temperature-cured off-flavor. Volatile profile analysis indicated the presence of two new unidentified compounds which might account for such a difference. The largest amount of typical off-flavor was found in peanuts cured 8 weeks after pegging. Less off-flavor was found in peanuts more mature than 8 weeks. They suggested that ethyl acetate was the major compound associated with this type of off-flavor since it was the only compound not found in the properly cured peanuts.

Singleton, *et al.* (42) studied the relationship between volatiles produced in peanuts cured at 22°, 35°, 45°, and 50°C and the evaluation of flavor and aroma by a taste panel. Acetaldehyde, ethanol, and ethyl acetate were reported to be compounds that might indicate flavor deterioration caused by high-temperature curing. They suggested that ethyl acetate in the volatile profile of peanuts could indicate off-flavor due to curing at elevated temperatures since it was not detected in peanuts cured at 22°C, showed only traces at 35° and 45°C, but was found in considerable quantity in samples cured at 50°C. They also suggested that changes in ratios between values represented by chromatographic peaks could be used to indicate flavor deterioration and improper treatment of raw peanuts.

Influence of Curing on Germination

Bailey, *et al.* (3) showed that seed viability was impaired when freshly harvested peanuts were cured at 49°C or higher. Loss of viability varied from slightly retarded

germination, abnormal growth of both shoot and root, death of the radicle growing point and complete lack of root development, to death of many seeds. Pickett and Holley (37) suggested that this loss of viability might be related to changes in certain critical constituents similar to those shown for protease, ascorbic acid, sulfhydryl, and possibly acid phosphatase when the curing temperature was 49°C and above. Studies by Young, *et al.* (49) indicated that good quality peanut seed can be produced by recommended bulk-curing methods.

Although dormancy is an inherent property of Virginia-type peanuts (22, 44) comparatively little is known about the nature of the dormancy. Hull (21) observed that the percent dormant seeds in peanuts was a function of temperature and time and that this percentage decreased as storage temperature increased from 3° to 40°C. Bailey, *et al.* (4) reported that dormancy of Virginia Bunch 67 peanuts was broken 40 days after harvest if the pods were held at 30°C and in 15 days if they were held between 40° and 50°C. When pods remained on plants in the ground or on stackpoles, dormancy extended considerably beyond 40 days.

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