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Effect of Moist Heat Treatment on Sensory Qualities of Peanut Kernels

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ABSTRACT

Shelled Florunner cv. peanut kernels adjusted to 12 to 13% moisture were subjected to heat treatments at 60, 90, and 120° C for periods of 1 and 2 hr. Kernels were then dried, oil-roasted, and examined for sensory qualities. Moistened, heated kernels were also inoculated with an aflatoxigenic strain of *Aspergillus flavus* and analyzed for free fatty acid (FFA) and aflatoxin contents at weekly intervals over a 6-week period of incubation at 30°C. Treatment of moist kernels at 60°C for 1 or 2 hr caused the FFA content to increase from 1.2% (unheated) to 2.2%, whereas treatment at 90 and 120°C for the same periods of time resulted in FFA contents ranging from 10.3 to 13.2%. After 6 weeks, the FFA content of all inoculated and control samples ranged from 11.5 to 14.5%. Sensory panel evaluations of uninoculated, roasted kernels indicated that moist heat treatment at 60°C did not significantly ($P \leq 0.05$) alter organoleptic characteristics; treatment at 90°C for 2 hr resulted in significantly lower scores for texture and flavor, whereas treatment at 120°C resulted in a general decrease in all sensory qualities. Kernels heated prior to inoculation with *A. flavus* did not appear to support growth as well as did unheated kernels early in the 6-week test period.

Key Words: *Arachis hypogaea*, peanuts, groundnut, fatty acid, sensory quality, aflatoxin, *Aspergillus flavus*.

Procedures for harvesting, storing, and marketing agricultural commodities require that moisture content and/or temperature be maintained at levels inhibitory for mold growth. For peanut (*Arachis hypogaea* L.) kernels, a safe moisture level is 7.5%, although many molds will not grow on kernels with moisture contents less than 9 or 10%. Mishandling of peanuts during storage or transport may result in an elevation of moisture to 12% or higher, creating conditions favorable for growth of *Aspergillus flavus*.

Considerable research attention has been directed toward defining environmental conditions for controlling growth of molds in grains and seeds, and for detoxifying commodities contaminated with mycotoxins. Treatment with chemicals and storage under various gas mixtures can be used with some success to retard fungal deterioration (3). Little information exists, however, pertaining to the effects of physical treatment prior to storage on susceptibility of peanuts to fungal deterioration during storage. The objective of this preliminary study was to investigate heat treatment of moistened peanuts as a potential method for increasing their resistance to production of aflatoxin by *A. flavus*. Chemical and sensory qualities of treated peanuts were examined.

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Materials and Methods

Florunner cv. peanut kernels were submerged in tap water, immediately drained, and allowed to remain at 22°C for 2 hr. Kernels (2 kg) were placed in ca. 1-cm layers in shallow pans, sealed, heated in ovens at 60, 90, and 120°C for 1 or 2 hr, and cooled to room temperature. Moisture contents of various samples ranged from 12 to 13% during heat treatment.

Aspergillus flavus NRRL-3517 was cultured on potato dextrose agar for 12 days at 30°C. Unheated (control) and heated peanuts were inoculated with conidia of *A. flavus* by inverting opened Petri dishes over the kernels and tapping gently. Kernels were then thoroughly mixed to assure uniform distribution of conidia. Initial vaible population of *A. flavus* was determined to range from 4 to 6 x 10^4/g. Inoculated and uninoculated kernels were separately deposited in sterile glass jars and incubated at 30°C for periods ranging to 6 weeks.

Samples were examined periodically for appearance of mold mycelium and conidia. Aflatoxin contents of 20-g samples of ground kernels were determined at weekly intervals during the 6-week test period according to procedures described in a previous publication (2).

The effects of moist heat treatment on free fatty acid (FFA) content and sensory qualities of peanut kernels were determined. Levels of FFA in inoculated kernels were determined using an alkali titration technique (1). Preparation of uninoculated, heat-treated and control kernels for sensory quality evaluation consisted of blanching in a rotisserie oven at 204°C for 9 min, removing skins, and roasting in coconut oil at 160°C for 6.5 min. Salt (1%, wt/wt) was added to warm kernels before subjecting them to evaluation by a 10-member panel. A 9-point quality scale (9 = excellent, 5 = borderline, 1 = extremely poor) using a randomized complete block was used to assign scores for appearance, color, aroma, texture, and flavor.

Significance of differences in mean values was determined by Duncan's multiple range test and are reported at $P \leq 0.05$ level.

Results

The percentages of FFA (calculated as oleic acid) for heated and unheated (control) kernels inoculated with *A. flavus* are shown in figure 1. Treatment of kernels at 60°C did not substantially increase the amount of FFA initially; however, growth of *A. flavus* on these kernels resulted in a more rapid rate of increase in FFA content compared to controls. Thus, both heat and lipolytic acitivity of *A. flavus* contributed to increase in FFA. Pattee and Sessoms (5) also reported that *A. flavus* had substantial lypolytic activity when cultured on moistened peanuts.

When kernels were heated at 90 and 120°C, considerable hydrolysis occurred. After approximately 4 weeks at 30°C, FFA in inoculated kernels increased to a range of 11.5 to 15.5% and remained relatively constant until the end of the test period.

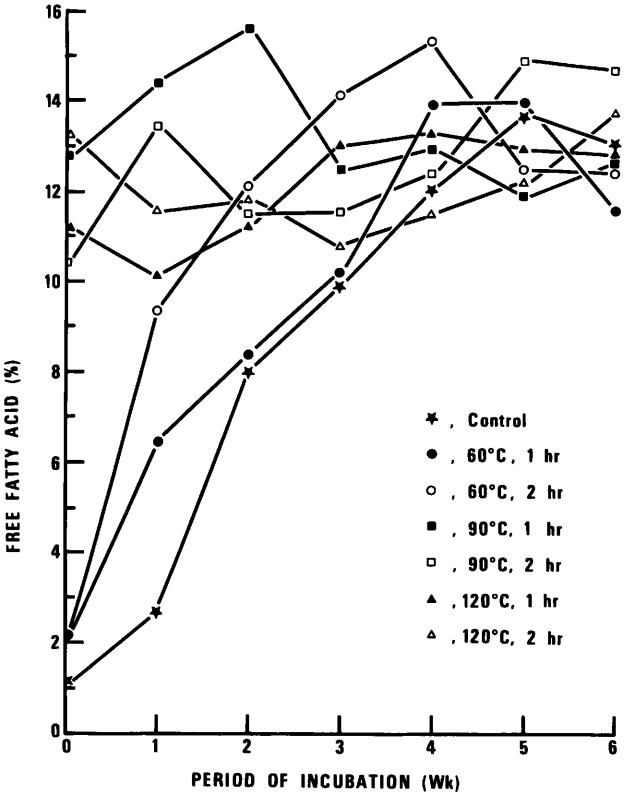

Fig. 1. Free fatty acid contents of moistened peanuts heated at 60, 90, and 120°C, inoculated with *A. flavus*, and held at 30°C for periods of time ranging to 6 weeks.

No aflatoxin was detected in uninoculated control or heated kernels. It appeared that treatment at 90 and 120°C may have inhibited the production of aflatoxin early in the incubation period. Visual observations revealed that mycelium production was definitely retarded during the first week of incubation of peanuts which had been moist heat treated.

Scores for sensory qualities of oil-roasted peanuts which had been exposed to moist heat treatment are shown in Table 1. Treatment at 60°C for 1 or 2 hr and at 90°C for 1 hr did not result in significant ($P \leq 0.05$) decreases in scores assigned for any of the sensory qualities evaluated. Scores for texture and flavor of peanuts heated at 90°C for 2 hr were significantly lower than those of the control, whereas scores for appearance of kernels heated at 120°C for 2 hr and for color, aroma, texture, and flavor of kernels heated at 120°C for 1 or 2 hr were significantly lower than those of the control. When the time for oil-roasting of kernels which had been subjected to 120°C was reduced from 6.5 min to 3.5 min, some improvement in color and aroma was noted.

Discussion

Preliminary studies indicate that moist heat treatment may have some potential as a procedure for retarding growth and production of aflatoxin in peanuts with moisture contents slightly above maximum levels traditionally used for preservation. Beneficial effects of treatment may be restricted to a short period of time at which moisture content is elevated. However, from a practical viewpoint, minor fluctuations in moisture are likely to occur more often than are prolonged periods in which moisture is elevated to levels conducive for mold growth.

Table 1. Sensory Qualities of Oil-Roasted Peanuts which had been exposed to Moist Heat Treatment.

Temperature of treatment (°C)	Time of treatment (hr)	Sensory score[1]				
		Appearance	Color	Aroma	Texture	Flavor
Control	0	6.6bc	6.8a	7.3a	7.3a	7.0a
60	1	7.4a	7.2a	7.2ab	7.5a	6.6abc
	2	7.3a	7.3a	7.4a	7.5a	6.3abcd
90	1	6.9ab	7.0a	7.0ab	6.9ab	6.8ab
	2	6.5bcd	6.6abc	6.9abc	6.1bcd	5.4d
120[2]	1	6.1bcd	6.0bcd	6.3c	6.4bc	5.7cd
	2	5.8d	5.6d	7.2ab	6.1bcd	5.4d
120[3]	1	6.5bcd	6.7ab	7.2ab	5.9cd	6.2bcd
	2	5.9cd	5.9cd	6.6bc	5.4d	5.5d

[1]Values in the same column not followed by the same letter are significently different ($P \leq 0.05$)

[2]Oil-roasted at 160°C for 6.5 min.

[3]Oil-roasted at 160°C for 3.5 min.

The lack of deterioration in sensory qualities of heated peanuts was somewhat surprising. Apparently moisture content in the range of 12 to 13% has some protective effect against degradation. The level of off-flavor in peanuts has been shown by others to be a function of curing temperature, time of exposure to the temperature, moisture content, and maturity stage of kernels (4). Off-flavors are produced more readily in kernels containing about 25% moisture compared to kernels containing higher or lower moisture. Observations made in the study reported here indicate that undesirable flavors, as well as other sensory qualities, do not develop in moistened peanuts heated for as long as 2 hr at 60°C. Further investigations are needed to fully predict the effects of moist heat treatment on peanuts and on the usefulness of this procedure for inhibiting fungal growth.

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