Microwave Vacuum Drying Effect on Peanut Quality[1]

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ABSTRACT

Florunner peanuts (*Arachis hypogaea L.*) were grown during the 1984 season near Tifton, Georgia. Two planting dates spaced one month apart were used to obtain four weekly digging dates. Peanuts from each harvest were windrow dried for 4 days, mechanically harvested and placed into a ventilated wagon for 1 to 4 days. Peanuts were subsequently removed from the wagon, shelled at 8 to 22% moisture (wb), and microwave vacuum dried at nominal rates of 4, 8, 16, and 32 times the normal rate of conventional wagon drying. Harvest group, microwave treatment level, and order of processing were configured in a Latin Square design. Concurrent with each microwave run (MV), a separate portion of the shelled peanuts was deep bed dried (CS) and another portion was similarly dried but within shell (CH). Analyses of variance were performed to determine the significance of treatment type, microwave level, harvest group, and processing order differences on splitting and skin slippage tendencies, mold growth, and germination potential. No significant ($p > .05$) differences were observed among treatment types for splitting and skin slippage potential, though slight ($p < .05$) differences existed among microwave treatment levels (damage increasing with increasing microwave drying rate), and drying order within microwave treatment (damage decreasing with increasing drying order). Larger ($p < .01$) splitting and skin slippage differences existed among harvest groups. MV treatments had significantly ($p < .01$) higher presence of *A. flavus* than the CS and CH treatments though aflatoxin was not detected in any sample. The percentage of normal strong germinated kernels from MV treatments was significantly ($p < .01$) lower than from the CS and CH treatments, with germination decreasing with increasing microwave process rate.

Key Words: Peanuts, drying, microwave, vacuum, *Aspergillus flavus*, germination, splitting, skin slippage.

Mechanized harvesting and curing of peanuts (*Arachis hpogaea L.*) is used almost exclusively by the peanut industry in the U. S. today. Harvest methods include digging and inverting the plants for windrow drying. Peanuts are typically combined at 20% (wet basis) and loaded into crop drying wagons. Forced air is used to lower the moisture content to 8-10%. Liquified petroleum gas (LPG) is most commonly used in wagon drying. Assuming gas cost $0.21 per liter the cost of drying peanuts is $7.25 per metric ton at an incoming moisture content of 20% (5).

To maintain acceptable flavor and milling characteristics peanuts are conventionally dried with the incoming air heated to no higher than 35 C (4). This upper limit may have to be further reduced to prevent the relative humidity of the drying air from becoming less than 60% (15). These temperature and humidity restrictions can result in drying times in excess of 30 h for peanuts above 20% moisture in standard drying wagons. Numerous studies have been conducted in an attempt to reduce drying time and energy cost. Cycling of heaters has been examined in full scale wagons (5) and smaller scale drying bins (18), with both studies demonstrating only slight advantages in time and energy. Solar assisted dryers which utilize a solar-heated water system and solar-heated air with rock storage average 41% and 74% savings, respectively, in added heat with no increase in time for standard wagons (14).

Few studies have been conducted that examine the effects of vacuum drying on peanuts. Moisture removal rates of 5% per h on a dry basis were accomplished for freshly dug peanuts (with no discernable off flavors) when vacuum dried in an oven with a wall temperature setting of 66 C (7). However, a reduction in germination and milling quality attributed to excessive drying rates, overdrying, and excessive temperatures was noted for vacuum treated samples. To date, there appears to be limited reported information (9,10) of the effects on peanuts subjected to vacuum drying with microwave power.

The objectives of this research were to examine the feasibility of microwave vacuum dried peanut by investigating: 1) the energy aspects of drying, 2) the physical properties of dried kernels (splitting and skin slipping), 3) changes in the microfloral population on kernels and, 4) germination efficiency.

Materials and Methods

Microwave vacuum drying was performed in a pilot-scale dryer designed and manufactured by the McDonnell Douglas Corporation (St. Louis, MO) and the Aeroglide Corporation (Raleigh, NC) (10). Basic operation principles consisted of passing a stream of peanut kernels through an evacuated (10-50 mm Hg absolute pressure) vessel while in the presence of a microwave energy field of 2450 MHz. Peanuts were microwave dried in a batch continuous operation with an upper storage hopper (0.67 m^3 capacity) used to supply a vertically mounted polyester sock (152 mm diameter, 2.90 m length) subjected to microwave energy. Kernel flow through the sock was regulated by a variable speed paddle feeder located directly below the sock. Microwave power was supplied by two 6 kW power sources (Cober Electronics, Stamford, CT) and was transmitted to the drying cavity via waveguides. Processed kernels were collected in a hopper below the feeder. Since the upper storage hopper, processing region and collection hopper formed a continuous airspace, dried peanuts were removed in batches by venting the drying cavity to atmospheric pressure. A 1.4 m^3/min vacuum pump (Model 55-50 Beach-Russ Co., New York, NY) driven by a 1.5 kW motor provided the necessary low operating pressure and served in the partial removal of water vapor. The remaining vapor was removed as condensate from the interior vessel wall (which was water cooled on the exterior side).

Florunnner peanuts were planted on May 4, 1984 and June 7, 1984 and grown on a Tifton Sandy Loam soil according to conventional cultural practices (8) near Tifton, Georgia. Harvesting occurred over four dates, with each harvest containing enough peanuts for four microwave treatment levels and corresponding conventional checks (Table 1). Because of the perishability of high moisture peanuts, drying order was considered in the analysis. For each harvest, approximately 1200 kg of peanuts were windrowed, combined, cleaned with a conventional farm-

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er's stock precleaner, and placed in a standard drying wagon. An axial fan connected to the plenum of the wagon was controlled by a time clock to run for one minute of every twenty to prevent excessive heat build-up from respiration.

Table 1. Growth history of Florunner peanuts used in study.

Harvest	Date Planted	Digging Date	Combining Date	Moisture Content at Combining (% wb)
1	5-4-84	9-14	9-18	24.5
2	5-4-84	9-21	9-25	14.2
3	5-4-84	9-28	10-01	28.2
4	6-7-84	10-05	10-08	25.5

Before each microwave drying run, approximately one quarter (300 kg) of the peanuts from each respective harvest were removed from the drying wagon and shelled to facilitate flow through the microwave dryer. The moisture content at shelling ranged from 8 to 22% (wb) with most treatments at 12% or greater. Previous research (6) has demonstrated that shelling efficiency, defined as the percent of pods shelled in one pass, is greatest at 14-15% (wb). A small portion (25 kg) of whole pods was set aside as a check sample (CH). These were concurrently dried by forced air box dryers equipped with finned electric heaters set to not exceed 35 C. Another portion of shelled kernels (CS) were dried in a manner identical to the CH peanuts.

The temperature, moisture, power, and process volume conditions for each microwave run are summarized in Table 2. The four selected drying rates, 4X, 8X, 16X, and 32X represent the number of times faster than the nominal rate of microwave drying was set compared to conventional wagon drying. Peanuts for each microwave run were loaded into the upper hopper, at which time a moisture sample was gathered. ANSI type T thermocouples were used to measure the temperature of the peanuts in the upper hopper (inlet temperature) and in the feeder supply box (exit temperature). Drying time, which has been made synonymous with travel time of a peanut kernel through the microwave region, was regulated by the feeder drive setting. Flow rate was calibrated prior to the drying runs. The desired time for drying was determined by the difference between the measured initial moisture content and the desired final moisture content divided by the product of a nominal average conventional drying rate of 0.5% (wb) per hour and the predetermined treatment rate factor (4X, 8X, 16X, or 32X). Microwave power levels were determined such that the power setting integrated over the residence time would match the amount of energy necessary to dry the peanuts from their initial measured temperature and moisture content to the desired final temperature and moisture content. This is expressed by the equation,

$$Q = \gamma_{dry}\, c_{dry} (T_f - T_i) + \gamma_{dry}\, c_w \left[\frac{mc_i}{(1 - mc_i)} \right] (T_f - T_i) + h_{lg}\, \gamma_{dry} \left[\frac{mc_i}{(1 - mc_i)} - \frac{mc_f}{(1 - mc_f)} \right] \quad [1]$$

where,

Q = Energy per unit volume, kJ/m³

γ_{dry} = Bulk density of dry kernels, kg/m³

c_{dry} = Specific heat of dry kernels, (1.880 kJ/(kg-C))

Table 2. Microwave vacuum drying test conditions.

Harvest-Order of Drying	Drying Rate	Ave. Net Microwave Power (W)	Total Apparent Electrical Energy to Microwave Power Supplies (kVAh)	Processing Time (hr)	Inlet Temp (C)	Exit Temp (C)	Initial m/c (%wb)	Final m/c (%wb)	Volume Processed (m^3)
1 - 1	4X	940	17.4	8.30	18	42	17.0	9.8	0.106
- 2	8X	2000	18.4	4.00	19	45	15.0	10.0	0.145
- 3	16X	3800	4.4	0.57	23	41	8.2	7.4	0.132
- 4	32X	7200	3.7	0.25	24	46	8.0	7.6	0.119
2 - 1	8X	1800	12.2	3.00	17	49	13.5	8.0	0.074
- 2	16X	3600	10.8	1.50	18	51	12.0	8.5	0.122
- 3	32X	7600	5.3	0.33	20	52	9.6	9.0	0.112
- 4	4X	1000	8.0	3.00	14	37	9.4	7.0	0.103
3 - 1	16X	3800	27.7	3.50	14	57	21.8	7.4	0.090
- 2	32X	7200	23.0	1.50	13	76	18.0	7.2	0.093
- 3	4X	1000	21.6	8.25	15	45	16.2	6.8	0.077
- 4	8X	2000	11.2	2.50	14	49	12.0	8.1	0.100
4 - 1	32X	7200	30.6	2.00	17	76	20.6	6.3	0.090
- 2	4X	1000	28.8	11.00	16	46	20.4	7.3	0.077
- 3	8X	1800	20.8	5.00	16	53	16.7	7.5	0.087
- 4	16X	3600	12.8	1.67	17	57	13.0	9.0	0.109

T_f & T_i = Final and initial temperature of kernels, (C)

mc_i & mc_f = Initial and final kernel moisture content, (wb)

c_w = Specific heat of water, (4.187 kJ/(kg-C))

h_{lg} = Heat of vaporization of water, (2.418 x 10^3 kJ/kg @ 35 C).

Total apparent electrical energy consumption of the microwave power generators was measured with a current transformer type power meter. This meter integrated the product of the measured curent value and the preprogrammed phase voltages over the time of processing. Samples of processed peanuts were not drawn until the estimated time to clear the volume of peanuts contained in the product sock had elapsed. This insured that the samples were subjected to the calculated amount of microwave energy. The bulk volume of peanuts which passed through the feeder from the start of the microwave run was measured. The total dry weight of peanuts processed during each microwave run was calculated as the product of the volume processed times a measured average dry bulk density of 0.56 g/cm³. An assumed power factor of 0.90 was applied to the measured total apparent electrical energy to estimate the actual energy supplied to the microwave generators. Microwave energy was determined as the product of the average net microwave power times the processing time. Absorbed energy was determined from incoming and exiting peanut temperatures and moisture contents through application of the energy relation expressed in equation 1. A 7 kg sample was drawn from below the feeder and immediately bagged in open paper sacks and placed in a 5-10 C cooler. Another 1 kg sample was used for moisture determination by the oven method in accordance with ASAE standard S410.1 (2). An equal amount of peanuts were placed in cold storage from the CS and CH counterparts of each run. Drying time for the CS and CH treatments was set to ensure that the peanuts reached a moisture content of 10% (wb) or less.

Energy values for microwave vacuum processing were compared with conventional wagon drying. The amount of propane energy and ambient energy was determined for 40 standard sized wagon loads (2.4 m x 4.3 m x 1.4 m deep) over the 1978 through 1984 harvest seasons (16). Each wagon contained a full load of peanuts and an airflow of approximately 4.7 m³/sec. The inlet air was heated approximately 15C above ambient though never exceeded a thermostat setting of 35C. Ambient energy was determined from the enthalpy difference between the dry bulb temperature of the fan inlet air and the existing dew point temperature. Propane energy was determined from the enthalpy increase of air through the axial fan. Each microwave treatment (MV) and its corresponding CS and CH counterparts were usually completed in one day so that four days were required to complete the drying of each harvest.

Percentage of Jumbo, Medium, and #1 kernels (hereafter designated as the large kernel fraction) was determined for each dried sample by screening on a 6.4 x 19 mm slotted screen and then removing any split, shriveled, molded or otherwise visibly damaged kernels which rode the screen. The large kernel fraction was calculated as the weight of the large kernels divided by the total sample weight.

Incidence of fungi was determined by placing 100 randomly selected large kernels per treatment on an *A. flavus - A. niger* selective medium and incubating at 30 C for 7 days. The same procedure was repeated using a 10% malt salt medium. Both procedures are described in detail elsewhere (17). Presence of B_1, B_2, G_1, and G_2 aflatoxins was determined for all treatment samples by HPLC (13).

The ability of peanuts to withstand abrasion was measured by tumbling 100 large kernels of each treatment for five minutes in an eccentrically mounted cage constructed per ASAE Standard 410.1 (3). The percentage of damaged kernels was determined by counting the number of split (divided by two) and bald kernels. This test was replicated four times and averaged.

Seed germination was evaluated by treating four replications of each treatment (25 seeds each) with a fungicide dust, rolling them in wetted germination papers and storing them at 24 C in a high humidity incubator. The fungicide's active ingredients were 1.13 g each of dicloran and captan per kg of seed. Since little germination had occurred in 13 days, the rolls were sealed in plastic bags with 200 ppm ethylene for 3 days, vented and kept in the incubator 3 more days before counting the normal strong and the abnormal diseased seeds in accordance with APRES Quality Methods (1).

Analyses of variance (AOV) (12) were performed to determine the significance of treatment type, microwave level, harvest group, and processing order differences on the large kernel fraction, fungal growth, abrasion damage, and germination potential. Harvest group, microwave treatment level, and order of processing with the microwave dryer were configured in a Latin Square design. The F-test results reported in the following section are reported as statistically significant when the confidence level exceeded 95%. Confidence levels in excess of 99% are separately noted. All comparison of means procedures were performed at the 95% confidence level using Waller Duncan's test.

Results and Discussion

Energy Consumption

Initial moisture contents decreased with increase in drying order and in some cases, particularly in the first and second harvests, reached a safe storable level prior to the drying treatment (Table 2). In keeping with the experimental design procedure, these treatments were still subjected to microwave vacuum drying with power and feeder speed settings selected to reduce the moisture content approximately 2%. Energy per unit dry kernel mass was plotted against moisture loss in Fig. 1. Moisture loss in this figure has been defined on a dry basis so that a unit value of m/c represents a constant value of water throughout the entire abscissa. Electrical, microwave, and absorbed energy behaved linearly with moisture loss as indicated by the respective coefficients of determination of 0.95, 0.99 and 0.98.

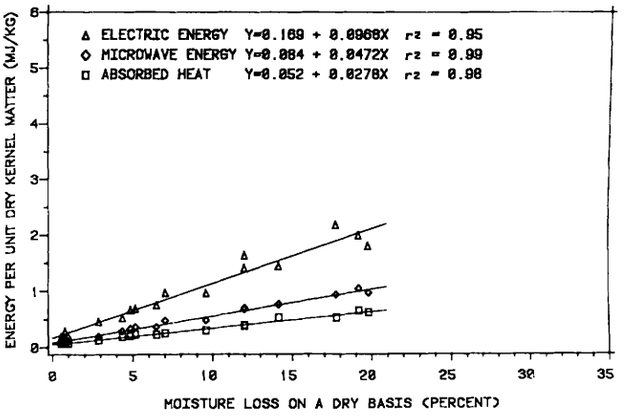

Fig. 1. Energy characteristics of the microwave vacuum treatments.

Ambient, propane, and total energy values per unit dry pod mass for conventional wagon drying were plotted against moisture loss in Fig. 2. Comparisons of Figs. 1 and 2 show that electrical energy required for microwave processing (0.0968 MJ/kg dry kernel per % moisture loss) matched very closely with the propane energy requirement for conventional drying (0.0994 MJ/kg dry pod per % moisture loss). The approximate similarity in the value of these two regression equation slopes indicates that for climatic conditions prevalent in southern Georgia the amount of energy which must be purchased (propane energy) for conventional drying appears to be greater than total electrical energy for microwave drying by a value equal to the fraction of total pod to kernel weight.

Physical Properties

Average percentage of the large kernel fraction for treatments, harvests, and drying orders are presented in Table 3. Differences within the microwave treatment group were not significant. Main treatments were sig-

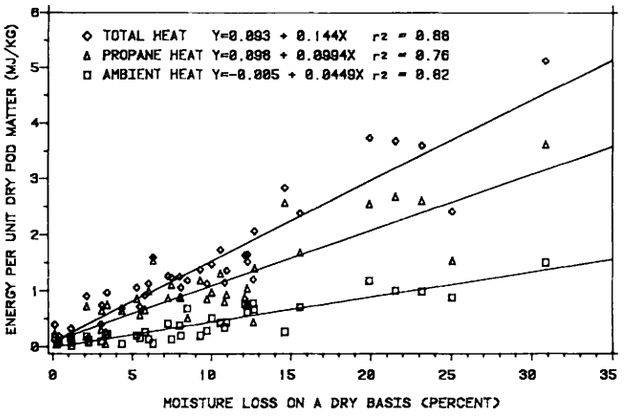

Fig. 2. Energy characteristics of conventional wagon drying.

nificantly different, with the CH treatment showing the highest percentage of large kernels and the MV treatment showing the lowest. Aside from the microwave vacuum drying itself, rougher handling of the kernels during processing may account for the lower large kernel fraction values in the MV treatment group. The kernels which comprised the samples for the MV treatments were subjected to a free-fall drop of approximately one meter before striking the inclined (30° from vertical) interior aluminum surface of the lower hopper. Previous research (11) has demonstrated the positive correlation between split kernels and drop height. Consequently, the number of damaged kernels removed from the samples during the screening procedure for the large kernel fraction determination were possibly augmented by free-fall impact damage. Significant differences of the large kernel fraction were observed among the harvest means, though it is uncertain whether these differences became manifested in the maturation stage, the combining stage or in the shelling stage.

The large kernel fraction of the microwave treated peanuts grouped by drying order showed significant differences. Table 3 indicates that the large kernel fraction improved with drying order for the MV treatments, though the comparison of means procedure found only the first in order to be significantly different from the subsequent three. The same trend was evident for drying order within the CS treatment group, with the large kernel fraction ranging from 78.7% (order one) to 86.3% (order four). The CH treatment group, on the other hand, had no apparent trend and had a large kernel fraction that differed by less than 2% across all orders. Such slight differences in drying order within the CH group seem plausible, considering that the conventional in-shell drying treatment was not radically different than the drying that the peanuts received while in the ventilated wagon. From these observations, it is speculated that the large kernel fraction is improved when shelling is done after drying.

Results of the abrasion and durability test are also presented in Table 3. While no significant differences were found to exist among the three major drying treatments, slight differences were significant among the

Table 3. Average percentage of large kernels and percentage of bald and split kernels produced from an abrasion test over drying treatments, harvest date, and drying order within microwave treatment.

Treatment	Harvest	Drying order within microwave treatment	Large Kernel Fraction (%)	Bald & Split kernels (%)
4X	-	-	80.6	4.9 ab
8X	-	-	85.2	1.9 a
16X	-	-	82.2	4.3 ab
32X	-	-	81.0	8.2 b
MV*	-	-	82.3 b	4.8
CS	-	-	83.7 ab	3.9
CH	-	-	86.0 a	3.5
--	1	-	86.1 a	0.8 a
--	2	-	85.3 a	4.6 b
--	3	-	81.1 b	6.6 b
--	4	-	83.4 ab	4.4 b
--	-	1	76.8 b	9.6 b
--	-	2	83.3 a	3.4 a
--	-	3	84.2 a	4.3 a
--	-	4	84.7 a	2.1 a

* MV represents the average of all microwave treatments.

Means followed by the same letter in each column group are not significantly different at the 5% level using Waller Duncan's comparison of means.

treatment levels within the microwave group. Kernels from the lower microwave process rates showed less damage than those at the higher microwaves rates. Differences in the percentage of bald and split kernels among harvest dates were significant. A comparison of means indicated that the differences within this group were small with the exception of the peanuts from the first harvest which were less damaged than the peanuts from the other three harvests. Significant differences in the percentage of bald and split kernels were observed among the drying order within microwave treatment. The tendency for kernels to be less damaged as the drying order of the microwave treatments increased appears to agree with the lower mean number of damaged kernels in the CH treatment when compared to the MV group. Those microwave treatments which were the later runs within each harvest lost much of their moisture while in the ventilation wagon. Consequently, these peanuts were dried in a manner similar to the CH treatment.

Fungal Activity

A summary of the fungal incidence of samples drawn from all treatments and placed on an *A. flavus - A. niger* selective medium and a 10% malt salt medium are presented in Table 4. Among the microwave drying rate treatments, the *A. flavus - A. niger* selective medium showed a trend for the other aspergilli category to in-

crease in number as the drying rate increased. The Waller Duncan's comparison of means procedure indicated that other aspergilli were significantly higher for the highest drying rate when compared to the two lowest levels. The reverse trend, with no significant differences, was noted for Phycomycetes. Other fungi showed significant differences though no trend with microwave drying rate was apparent. For kernels placed on the 10% malt salt medium, only the *A. niger* category showed significant differences among microwave drying rates, with a trend for more *A. niger* growth with lower rates of microwave treatment.

flavus - A. niger selective medium and for *A. flavus, A. niger,* and other aspergilli grown on the 10% malt salt medium.

Germination Potential

The means of the normal strong and abnormal diseased germinated seed from the three main treatment groups, microwave treatments among themselves, harvest date, and order of drying within the microwave group are presented in Table 5. Seed from CH peanuts were significantly higher in strong germination and had less disease than seed from the CS treatment. Seed from CS peanuts had significantly better germination than seed from MV

Table 4. Average percentage of kernels infested by indicated fungi grown on an *A. flavus - A. niger* selective medium and a 10% malt salt medium by treatment and harvest.

		A. flavus-A. niger selective medium					10% malt salt medium				
Treatment	Harvest	A. flavus	A. niger	Other aspergilli	Phycomycetes	Other fungi	A. flavus	A. niger	Other aspergilli	Phycomycetes	Other fungi
4X	-	47	52	4 a	16	40 a	38	45 b	57	2	36
8X	-	53	51	13 a	12	48 ab	27	39 ab	80	3	44
16X	-	56	34	17 ab	12	61 b	30	24 ab	71	0	41
32X	-	45	32	30 b	4	36 a	26	17 a	73	2	35
MV*	-	50 c	42	16 b	11	46 a	30 c	32	70 c	2	39 a
CS	-	30 b	40	10 ab	11	75 c	20 b	33	52 b	0	77 b
CH	-	18 a	38	4 a	12	66 b	11 a	30	26 a	3	40 a
--	1	58 c	28 a	7	20 c	51 a	34 c	17 a	67 c	6	44 a
--	2	36 b	33 a	8	14 bc	65 b	24 b	29 ab	51 b	0	53 ab
--	3	23 a	55 b	16	5 a	64 b	16 ab	44 c	44 b	0	58 b
--	4	14 a	46 b	8	6 ab	70 b	8 a	36 bc	34 a	0	52 ab

* MV represents the average of all microwave treatments.

Means followed by the same letter in each column group are not significantly different at the 5% level using Waller Duncan's comparison of means.

Significant differences were found between the MV, CS, and CH treatments for the *A. flavus,* other aspergilli, and other fungi categories grown on both media. The pooled average of the incidence from microwave treatments consistently showed a higher incidence of the *A. flavus* and other aspergilli categories and a lower incidence of the other fungi category when compared with the CS and CH levels. The relatively low incidence of *A. flavus* contaminated CH kernels suggests that the high moisture shelling process and subsequent high moisture kernel to kernel contact during handling were responsible for the comparatively high level of *A. flavus* on MV and CS treatments.

The incidence of other fungi which grew on the 10% malt salt medium was found to be significantly different between harvest dates. Highly significant differences ($p < .01$) were found between harvests for *A. flavus, A. niger,* phycomycetes, and other fungi grown on the *A.*

peanuts. Comparison of germination of strong and diseased seed for the drying rate levels within the microwave treatment indicate that germination performance declined with increased process rate. Individual seed counts within each germination sample tend to indicate that the elevated kernel temperatures that resulted from an increased microwave drying rate were responsible for the diminished seed vitality. Peanuts from harvests 3 & 4 at the 32X drying rate had a processed kernel exit temperature of 76 C and failed to germinate, while growth of aspergilli molds were evident on each roll. These can be contrasted to corresponding normal strong percentages of 95 and 73 for the 32X treatments from harvests 1 & 2 which had processed kernel temperatures of 46 C and 52 C, respectively. The tendency toward a decreasing fraction of normal strong seed with increasing temperature is illustrated in Fig. 3. The mean value of normal strong germinated seed for each microwave treatment is plotted

against its corresponding exit temperature. Though linear or any other form of simple regression does not correlate highly with this experimental data (linear regression r^2 = 64%), a downward trend exists for normal strong germination with increased process temperature. Seed germination potential appears to be substantially affected when seed temperatures exceed 50 C.

Table 5. Average percentage of normal strong germinated seed and abnormal diseased seed over drying treatments, harvest date, and drying order within microwave treatment.

Treatment	Harvest	Drying order within microwave treatment	Normal strong germinated (%)	Abnormal diseased (%)
4X	-	-	78 a	14 a
8X	-	-	61 ab	25 a
16X	-	-	65 ab	30 a
32X	-	-	42 b	57 b
MV*	-	-	62 c	31 c
CS	-	-	76 b	18 b
CH	-	-	88 a	6 a
--	1	-	85 a	4 a
--	2	-	92 a	6 a
--	3	-	50 c	44 c
--	4	-	73 b	20 b
--	-	1	44 b	52 b
--	-	2	62 ab	28 ab
--	-	3	59 ab	32 ab
--	-	4	82 a	14 a

* MV represents the average of all microwave treatments.

Means followed by the same letter in each column group are not significantly different at the 5% level using Waller Duncan's comparison of means.

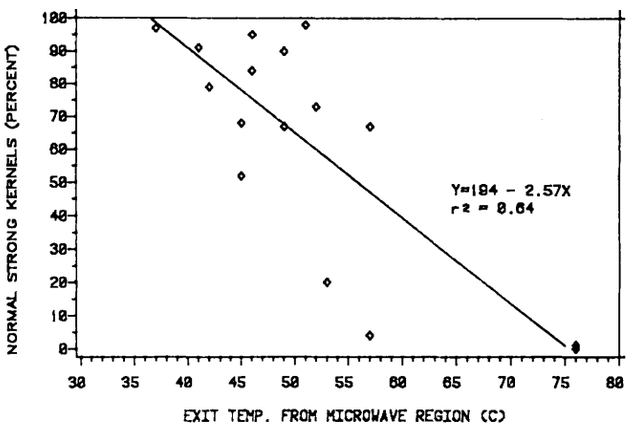

Fig. 3. The effect of kernel temperature on germination potential.

Conclusion

The results of this research indicate that while the total energy requirement for microwave vacuum dried peanuts can be less than that for conventionally dried peanuts, other factors such as fungal growth, seed germination potential, and kernel durability can be deleteriously affected by the microwave vacuum drying process. It appears that the practice of high moisture shelling followed by microwave vacuum drying can lead to elevated levels of *A. flavus* growth on peanut kernels. Seed vitality, as determined by the percentage of normal strong germinated seed, diminishes as the microwave processing rate increases. The ability of microwave vacuum dried kernels to withstand abrasion and impact forces appears to decline as the microwave process rate is increased. Further research is needed to determine which of the mechanisms in the microwave vacuum drying process (high moisture shelling, transport and handling, or microwave heating) is most responsible for affecting peanut quality.

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