

Effects of Maturity on the Development of Oleic Acid and Linoleic Acid in the Four Peanut Market Types

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Received: April 23, 2020

Accepted: May 27, 2020

Online Published: June 10, 2020

doi:10.5539/jfr.v9n4p1

URL: <https://doi.org/10.5539/jfr.v9n4p1>

Abstract

The commercialization of high oleic peanut varieties with the fatty acids, oleic and linoleic present in a ratio greater than 9 has increased the shelf stability of many products containing peanuts significantly. With no visual traits to determine levels of the fatty acids present, mixing of the high oleic peanut types from the normal oleic types has been a problem in the peanut supply chain. This study investigated the effect of the development of the fatty acids in peanuts over their maturation with respect to the different market types (Runner, Virginia, Spanish, Valencia) to determine if the maturation stage of the peanut could be responsible for the presence of normal oleic peanuts in lots of high oleic peanuts and thus decreasing the purity of the lots. Peanuts had different levels of the main fatty acids present as the oil content increased with maturation. Due to the presence of a natural desaturase enzyme in peanuts, oleic acid is converted to linoleic as the peanut develops resulting in a ratio of oleic acid to linoleic acid of 3 or lower in normal oleic peanuts. In peanuts from high oleic cultivars, the genes encoding for this enzyme are mutated or slow to develop. As this gene is activated in the later stages of peanut maturity, this study proves immature peanuts of the high oleic type may not have the proper ratios of oleic to linoleic to ensure shelf stability despite being from high oleic cultivars. This study describes how the concentrations of oleic and linoleic acid changed with maturation of the peanut seeds and affects the purity of individual lots of high and normal oleic types of peanuts. This effect of maturity was seen to be greater in the large seeded Virginia cultivars compared to the smaller seeded market types.

Keywords: peanut maturity, shelf-life, lipid stability, seed development

1. Introduction

The four peanut market types are Runner, Virginia, Spanish and Valencia. Different peanut products are produced from each cultivar (National Peanut Board, 2020). Runner peanuts, 38 to 70 seeds per ounce, depending on the grade, are used almost entirely for the manufacture of peanut butter but are often used in certain candies. Virginia type peanuts are usually the largest in physical size, 21 to 42 seeds per ounce, and are most often used for snack peanuts sold as “in-shells” or oil roasted peanuts sold in cans or single serve cellophane bags. The Spanish-type, 60 to 80 seeds per ounce, are sold as “redskin” peanuts in cans and may also be used in confections as they have the highest levels of sweet flavor. Valencia peanuts, 75 to 80 seeds per ounce, represent only about 1% of the USA peanut market and are usually consumed as “in-shell” product although they are sometimes used to produce peanut butter or confections.

Peanut seed development takes place entirely underground so that there is no practical way to monitor that development. Like other legumes, peanuts are the seed of the plant and develop from the stem of the flower which forms a peg and moves underground. In the early stages, starch is accumulated to serve as the energy source but then the production of lipid rapidly overtakes it (Pickett, 1950). Initially, the fatty acids produced by the seed are mostly linoleic and palmitic with slightly lesser amounts of oleic acid. As the seed matures, genes coding for fatty acid desaturases are turned on producing enzymes that begin converting oleic acid to linoleic acid. In 1980's, a mutation was discovered that resulted in peanuts having large amounts of oleic acid compared

to linoleic acid indicating the desaturases were not being produced or activated (Moore & Knauff, 1989; Norden, Gorbet, Knauff, & Young, 1987). When the mutation is present, the seed continues to produce oleic acid but little or none is converted to linoleic acid and the amount of oleic acid greatly exceeds that of linoleic. Genetic markers have been developed to identify the genotypes aiding in the development of peanut cultivars that contain the high oleic trait (Barkley, Chenault Chamberlin, Wang, & Pittman, 2010). However, peanuts pods achieve their final physical size before the seed inside is at final maturity and the oil composition is at its final state leading to the conclusion that despite the proper genetic makeup, an immature peanut may not necessarily have expressed the high oleic trait.

Peanuts contain approximately 50% lipid, mainly composed of triglycerides (Stalker, 1997). Of the fatty acids present in mature peanuts, 80% are a combination of oleic and linoleic acids (Davis, Dean, Faircloth, & Sanders, 2008). Optimum flavor and shelf life are therefore very dependent on the lipid quality. Peanut cultivars with increased levels of oleic acid have proven to have increased shelf life over conventional cultivars (O'Keefe, Wiley, & Knauff, 1993). High oleic (HO) peanuts are those where the ratio of the oleic acid content to the linoleic acid (O/L ratio) present in their lipids is greater than 9, while those below that ratio are considered normal oleic (NO). In some publications, peanuts with O/L ratios below 9 are referred to as low oleic (LO), but in this study, they will be designated as NO. In this study, peanuts were separated into the different maturity classes before analysis (Rucker, Kvien, Vellidis, Hill, & Sharpe, 1994). Although this method has been used for several decades, it is still the only method the peanut industry has to evaluate maturity in raw peanuts at harvest.

Manufacturers of food products containing peanuts prefer to use HO as they have reduced consumer complaints regarding rancidity. This improvement in peanut oil stability has resulted in the high oleic trait being introduced into all the market types and these cultivars are now commercially available. However, there is no visible indicator as to the O/L ratio of a peanut seed. Mixed lots of normal- and high-oleic peanuts has proven to be a challenge in the peanut supply chain that has seen an increase in the past decade (Klevorn, Hendrix, Sanders, & Dean, 2016). Sources of such mixing have more often been attributed to physical mixing along the supply chain from seed supplier to grower to shelling plant to final processor or to outcrossing in the seed itself (Davis, Price, Dean, Sweigart, Cottonaro, & Sanders, 2016). This is of major concern to processors of peanut products where the flavor of an individual peanut is the major part of the consumer experience. A single rancid peanut can result in a negative association for the consumer and loss of repeat purchases. This study is the first to systematically examine the effect of peanut maturity on the O/L ratio of peanuts of the four commercial market types to evaluate the possibility that a mixture of normal- and high-oleic peanuts is a consequence of the presence of immature peanuts as opposed to human error in the bulk handling of the peanut lots or due to plant outcrossing. Adding the sorting criteria of maturity to improve the purity of HO lots of peanuts will provide an economic advantage is reducing rancidity in processed peanut products and the resulting economic disadvantages of poor consumer response to the products.

2. Materials and Methods

2.1 Sample Preparation

Intact peanut plants were received at the USDA, ARS Market Quality and Handling Research Unit in Raleigh, NC, USA, within 24 hours of field harvest from the cooperators. HO Runner (Cultivar 68-17), NO Runner (Cultivar Tifguard), HO Virginia (Cultivar Spain) and NO Virginia (Cultivar Bailey) plants were harvested by the authors themselves from the North Carolina State University Peanut Belt Research Station in Lewiston, NC, USA. Plants of the HO Spanish market type (Cultivar Olé) and NO Spanish market type (Cultivar Pronto) were shipped overnight in refrigerated containers from the USDA, ARS Wheat, Peanut and Other Field Crops Research Center in Stillwater, OK, USA. Similarly, intact plants of the HO Valencia market type (Cultivar Valencia 308) and NO Valencia market type (Cultivar Valencia 309 Tan) were shipped from the University of New Mexico Department of Plant and Environmental Services (Clovis, NM, USA). Six plants of each cultivar (HO and NO) were harvested. Upon receipt, every seed from each plant was removed from the plant, evaluated for maturity using the "hull scrape" or "pod blast" method (Rucker et al, 1994). After seed separation, the seeds from each plant were loaded into a basket fabricated in house using size 24 mesh metal hardware screen. The seeds were then pressure washed with water using a Greenworks Model 1600 pressure washer (Sunrise Global Marketing, Mooresville, NC, USA). The standard vibrating nozzle was set to 1600 psi. This action resulted in the removal of the exocarp layer of the peanut shells and allowed for the seeds to be sorted by their exterior pod mesocarp color which is the industry standard for peanut maturity determination (Williams & Drexler, 1981). Seeds of the same maturity were packed in Ziploc® plastic bags (S.C. Johnson Corp., Racine, WI, USA) for each plant. The seeds from each plant were stored separately. For analysis, each individual seed was assigned a unique sample number. Each seed was weighed and a representative sample for fatty acid determination was

taken using the hollow needle method described by Zeile and others (1993). If the seed was of insufficient size for sampling, the entire seed was crushed and extracted.

2.2 Fatty Acid Determination

Representative samples obtained as described above were directly methylated as previously described (Klevorn et al, 2016). All chemicals and reagents used were purchased from Thermo Fisher (Fairlawn, NJ, USA) unless otherwise specified. In brief, 20 to 40 mg of each peanut seed sample were heated in 1.0 mL of 0.5 N NaOH in MeOH for 10 min at 85 °C in glass screw capped tubes using a water bath. After cooling, a 1.0 mL aliquot of 14 % BF₃ in MeOH solution (Sigma Chemical Corp., St. Louis, Mo., U.S.A.) was added and the tubes were sealed and reheated for 5 min. The tubes were cooled to room temperature and 1.0 mL of water followed by 1.0 mL of hexane was added. The tubes were vortexed for 15 sec to mix and extract the fatty acid methyl esters. The tubes were left to stand at room temperature until layers formed. The top layer (hexane) containing the fatty acid methyl esters was removed using a Pasteur pipet and passed through a bed of Na₂SO₄ (approximately 0.5 g) to remove any water present. The extract was then analyzed by GC.

The extracts were injected onto a Perkin Elmer Model Autosampler XL GC (Perkin Elmer, Shelton, CN, USA) fitted with a BPX-70 capillary column (30m x 0.25 mm i.d., 0.25 μ dry film) (SGE Analytical Science, Austin, TX, USA) and a flame ionization detector (FID). The temperature program was 60 °C for 2 min, increased to 180 °C at 10 °C/min, then increased to 235 °C at 4 °C/min for a total run time of 27.7 min. The injector was heated to 220 °C and the detector to 250 °C. The carrier gas was helium at a flow rate of 1.85 ml/min with a split flow rate of 40 mL/min. Retention times were established using the Kel-Fim FAME-5 standard mixture (Matreya LLC, Pleasant Gap, PA, USA) and the GLC-21A standard mixture (Nu-Check Prep, Waterville, MN, USA). The fatty acid content of the seeds was calculated by normalization according to AOCS method Ce 1-62 (Firestone, 2003).

3. Results

3.1 Maturity Determination

Due to the indeterminate flowering character of the peanut plant, when peanuts are harvested, every peanut present on a single plant will not necessarily be mature. Although not readily apparent when examining the intact peanut pod, the maturation stage of peanuts can be determined by removal of the top layer of the mesocarp of the shell (Williams & Drexler, 1981). When dampened, the actual color of this underlying level of the shell can be seen. As the peanut matures, the color of this layer changes progressively from white (most immature) to yellow to orange to brown to black (most mature). The shell also become thicker and develops a ridged texture. Determination of pod maturity in this study was done through use of this hull-scrape method (Williams & Drexler, 1981). Investigation of the four commercially produced market types in the United States, runner, virginia, spanish, and valencia, demonstrated that a clear relationship exists between seed maturity and development of O/L ratio. Previously, this relationship was established by the discovery that the most immature seeds (those with a white mesocarp) had O/L ratios almost entirely below the HO threshold of an O/L ratio of 9 or greater (Klevorn et al, 2016). As the mesocarp colors darkened, the range of O/L ratios present were higher. Pods with white, yellow, and orange A mesocarp colors are regarded as immature. Those with orange B, brown, or black mesocarp colors are considered as mature. Additionally, the phenomenon of increased O/L ratio with increased maturity was observed within the NO control cultivars included in the earlier study.

3.2 Fatty Acid Development

Since the peanut is the seed of the plant, there are a series of compositional changes that occur with its maturation. These include the increase and then decline of the simple carbohydrates, the production of amino acids and proteins and the production of the lipids and the change in fatty acid composition that is the topic of this investigation (Pickett, 1950; Sanders, Lansden, Greene, Drexler & Williams, 1982; Schenk, 1961). In addition, the pod and subsequently the seed inside increase in size at different rates, with the pod reaching nearly full size before the seed inside begins to develop.

Each of the four peanut market types has a specific plant growth pattern which result in different pod shapes and sizes as well as the lengths of growing season. The market types are characterized by distinct characteristics that dictate how they are used as food or in food products (American Peanut Council, 2020). In this study, all the peanuts from each of six plants of each market type were analyzed to determine their stage of maturity based on mesocarp color and all were analyzed for their fatty acid content regardless of the physical size of the pod. The samples were taken at the time of commercial harvest, which was the point best considered optimum for that market type. Runner type peanuts compose the major portion of the USA peanut crop (85%) and are used for

peanut butter and for confections. In Figure 1a, the range of seed sizes for the Runner peanuts in relation to their O/L ratios is plotted. Each point represents a single seed. The colors of the plot points correspond to the maturity class of the pod that the respective seeds were taken from. There is a clear relationship between the size of the seed and the maturation as determined by pod color and in the development of the fatty acids. The most mature seed as designated by the darkest color points are clustered around 1 g in seed weight and above O/L values of 30. It was previously reported that as peanuts mature, the levels of palmitic and linoleic acid decrease and the level of oleic acid increase (Sanders et al, 1982). The genes responsible for this are two recessive alleles of **ahFAD2A** and **ahFAD2B**. Of these, **ahFAD2A** has been shown to occur at a high frequency in runner and virginia types (Barkely et al, 2010). There are functional mutations, G448A in **ahFAD2A** and 442insA in **ahFAD2B** that are responsible for the elevated levels of oleic acids in peanut lipids as they eliminate or knock down desaturase activity (Jung et al, 2000). The O/L ratio increases as the pod color darkens but the seed size may not necessarily increase. In ordinary language, a big peanut is not necessarily a mature peanut (Sanders, 2015).

3.3 Runner-type Peanuts

Peanuts of the normal oleic (NO) Runner cultivar, Tifguard, were analyzed as the control and showed an increase in O/L ratio with increasing maturity as with the HO cultivar, (Cultivar 68-17); however, the values never increased above 3 (Table 1). Runner and Virginia type peanut plants are higher yielding than Spanish and Valencia types. For this study, the NO Runner cultivar, Tifguard, over 250 pods were produced by the plants sampled. The HO Runner cultivar produced over 350 pods. For the HO cultivar of the runner type, although a clear relationship was established between maturity and development of the increased O/L ratios, most of the pods crossed the threshold of O/L greater than 9 regardless of maturity (Figure 1a). The entire range of pod colors was found to be present at harvest. To make the data manageable, 40 pods of each were randomly selected from each maturity class of these cultivars for analysis of fatty acids. The data are presented graphically in Figure 1a for comparison. A few scattered seeds of advanced maturity were seen to fall below the threshold value of 9 indicating that plants can naturally contain these mixed levels of O/L values.

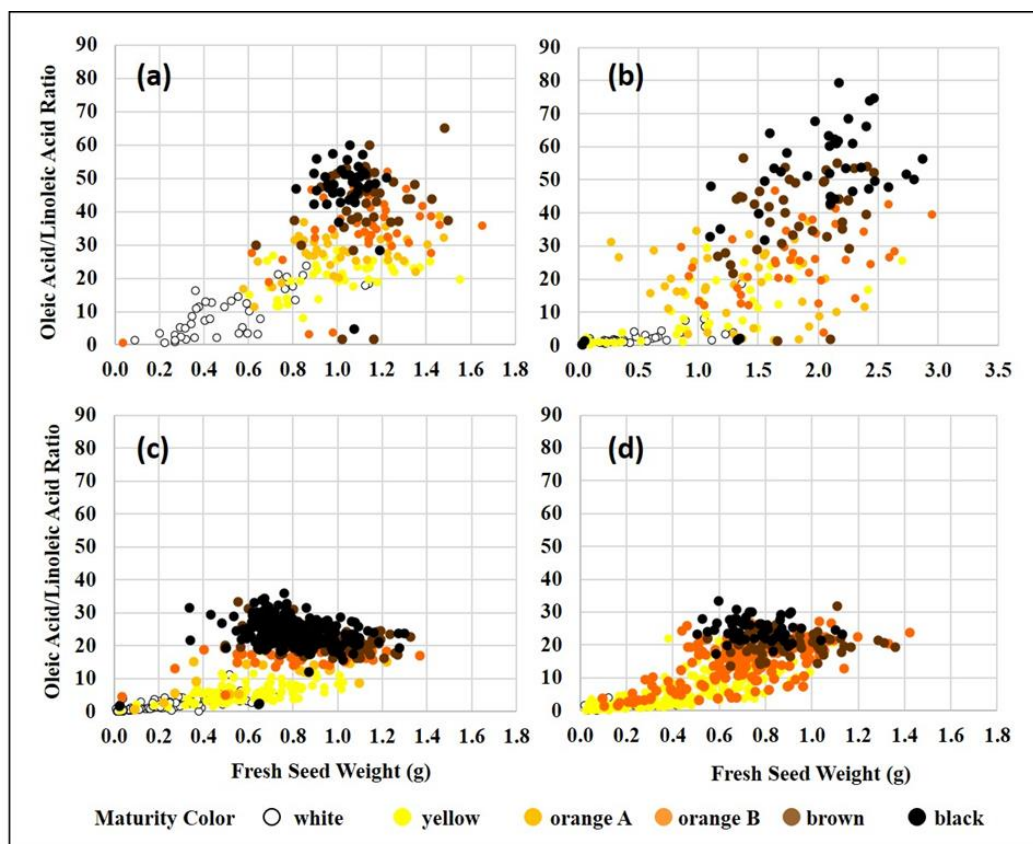


Figure 1. Variation in oleic acid-linoleic acid ratio with fresh seed weight by maturity color (a) Runner market type-variety “68-17”, (b) Virginia market type-variety “Spain”, (C) Spanish market type-variety “Ole”, (d) Valencia market type-variety “Valencia 308”

Table 1. Seed weights and Oleic to Linoleic Acid ratios for the peanut market types for each maturity class

Variety	Market Type	OL Type	Maturity Color	Number of Pods	Number of Seeds	Mean Wet Seed Weight (SD) <i>In grams</i>	O/L Ratio (SD)
68-17	Runner	high	black	20	40	1.04(0.09)	47.18(8.94)
			brown	20	40	1.13(0.17)	42.39(12.23)
			orange B	20	40	1.11(0.28)	33.83(11.20)
			orange A	21	40	1.03(0.23)	27.66(5.66)
			yellow	21	40	1.01(0.23)	20.46(4.85)
			white	20	40	0.51(0.24)	9.32(6.75)
Tifguard	Runner	normal	black	20	40	1.07(0.18)	2.44(0.85)
			brown	20	40	1.16(0.23)	1.94(0.44)
			orange B	20	38	1.05(0.24)	2.08(0.49)
			orange A	21	40	0.91(0.29)	1.69(0.35)
			yellow	20	38	0.99(0.20)	1.42(0.36)
			white	21	40	0.59(0.23)	1.21(0.35)
Spain	Virginia	high	black	21	40	1.93(0.63)	49.03(19.40)
			brown	20	40	1.83(0.38)	40.96(9.41)
			orange B	24	40	1.76(0.57)	25.57(10.14)
			orange A	26	40	1.32(0.52)	17.77(9.48)
			yellow	22	40	1.02(0.64)	10.38(8.76)
			white	26	40	0.51(0.37)	2.48(3.15)
Bailey	Virginia	normal	black	22	40	1.36(0.19)	1.99(0.19)
			brown	21	40	1.28(0.17)	1.80(0.24)
			orange B	23	40	1.25(0.28)	1.46(0.21)
			orange A	23	40	1.11(0.28)	1.33(0.18)
			yellow	25	40	0.91(0.25)	1.19(0.18)
			white	22	40	0.58(0.27)	0.94(0.25)
Ole	Spanish	high	Black	134	240	0.81(0.16)	24.05(4.52)
			Brown	77	131	0.92(0.17)	21.90(3.09)
			orange B	21	38	0.81(0.28)	16.26(3.40)
			orange A	14	21	0.66(0.34)	11.26(5.10)
			yellow	61	108	0.60(0.21)	6.42(4.10)
			white	61	96	0.24(0.18)	2.11(1.91)
Pronto	Spanish	Normal	Black	9	17	0.70(0.12)	1.21(0.13)
			brown	88	146	0.78(0.17)	1.21(0.12)
			orange B	35	61	0.82(0.14)	1.10(0.08)
			orange A	13	20	0.68(0.15)	1.04(0.08)
			yellow	81	115	0.47(0.20)	0.91(0.12)
			white	30	35	0.17(0.16)	0.64(0.34)
Valencia 308	Valencia	high	black	19	57	0.77(0.13)	24.60(3.35)
			brown	59	159	0.89(0.18)	20.78(3.10)
			orange B	32	92	0.77(0.24)	18.07(5.50)
			orange A	36	93	0.62(0.18)	12.47(5.88)
			yellow	76	178	0.45(0.26)	6.33(5.57)
			white	23	31	0.13(0.11)	1.36(1.12)
Valencia 309 TAN	Valencia	normal	black	1	3	0.59(0.05)	1.15(0.03)
			brown	17	39	0.74(0.15)	1.17(0.08)
			orange B	52	129	0.80(0.15)	1.05(0.09)
			orange A	63	132	0.78(0.18)	0.99(0.08)
			yellow	82	140	0.49(0.27)	0.78(0.21)
			white	5	7	0.19(0.10)	0.64(0.21)

3.4 Virginia-type Peanuts

Virginia type peanuts are the largest cultivars in physical size and make up 10% of the USA peanut crop (American Peanut Council, 2020). This type is often sold as roasted in the shell peanuts (“Ballpark Peanuts”) and are commonly salted. The Virginia type plants contained seeds that grew to larger sizes and the effect of immaturity is more evident (Figure 1b). The Virginia type peanut plants are also higher yielding than the Spanish or Valencia type. The NO cultivar, Bailey produced over 300 pods for the plants sampled. The HO cultivar, Spain, produced over 200 pods. As with the Runner type, a selection of 40 pods from each maturity class was analyzed and the data presented in Figure 1b. The O/L ratio increased as the pod color darkened but the seed size did not necessarily increase. As previously reported, seeds may already be to size before the optimum harvest time and not be expressing the high oleic trait but will be HO by harvest time (Klevorn et al, 2016). For this market type, very few of the very immature seeds, that is the white and yellow colors were above the threshold to be considered HO, compared to the runner type (Figure 1a). In addition, most of the smaller size seeds were not HO despite their maturity as determined by pod color. This indicates that for this market type, efficient sorting to remove small seeds is essential to prevent introduction of peanuts into finished products that will have a reduced shelf life due to onset of rancidity.

3.5 Spanish-type Peanuts

Spanish type peanuts are a minor part of the USA peanut crop (2%) (American Peanut Council, 2020). The main use of these peanuts is in candy or as roasted and salted. The Spanish type plants produced seeds that showed a close relationship between size and maturity (Figure 1c). As the Spanish plants were lower yielding, all the pods collected from the plants samples were analyzed. The peanuts of this market type tend to be relatively small with the majority being between 0.6 to 1.0 g in weight. Once the seed size increased about 0.5 g, few white pods were found. Mature (brown and black) pods appeared at that point. Yellow pods were found beyond the 0.5 g level but none above 1 g in seed weight. The largest number of the seeds were also mature from these plants at the harvest time compared to the other market types. One defining characteristic of Spanish type peanuts is their relatively short growing season (120 days after planting) compared to some runner types (150 days after planting) (Bell, Shorter & Mayer, 1991). Although the larger portion of the seeds analyzed of the Spanish type were mature at the harvest date, the O/L ratios did not reach the high values seen with the Runner and Virginia cultivars in this study. If this is a result of the shorter period of growth or genetic expression needs to be determined.

3.6 Valencia-type Peanuts

The fourth market type of peanuts is the Valencia type. Representing less than 1% of the total U.S.A. crop, most Valencia type peanuts are grown in the state of New Mexico (American Peanut Council, 2020). The primary application of these peanuts is for organic products such as peanut butter. The growing area is relatively free of plant diseases allowing for organic production (Chamberlin & Puppala, 2018). Other uses are as fresh roasted and boiled peanuts and as an ingredient in candy. The relationship between size and maturity (Figure 1d) is closer to that of the Spanish market type (Figure 1c). Like the Spanish type, all the pods collected from the sampled plants were analyzed and the data reported in the Figure 1d and Table 1. The smaller seed size of Valencia seemed to influence the number of immature seeds at harvest. There were very few white seeds and many of the seeds in the orange B category that were less than 0.5 g in size compared to the Runners (Figure 1a) and the Virginia types (Figure 1b). The very mature seeds (brown and black pods) of the Valencia type made up a smaller portion of the total than for the Spanish type. This would indicate that sorting by size would not be as effective as for the larger seeded types in removing immature kernels that have the potential for producing off flavors due to lipid oxidation. As with the Spanish type, the Valencia type did not have O/L ratios above 30 indicating that although the amount of oleic acid present in the seed was similar to that in the larger seed varieties, the linoleic acid levels were higher allowing for greater opportunities for lipid oxidation.

4. Discussion

Specifically, advanced pod maturity has been linked to increased levels of oleic acid and decreased levels of palmitic and linoleic acid (Sanders et al, 1982). A strong relationship was observed in this study between increased O/L ratios and more advanced maturity. Increased O/L ratio with increased maturity was present for all four market types yet the extent of this relationship appeared to differ among the market types. When modeling the development of O/L ratio using mesocarp color and market type as predictors, a significant interaction between mesocarp color and market type was observed. The presence of a significant interaction term confirmed the visually observed variability in the relationship between O/L ratio development with darker mesocarp colors between the four market types (Table 1). For the HO Runner market type, there was a small, but not significant increase in the O/L ratio from 1.21 (white pods) to 2.44 (black pods). For the HO Runner cultivar, even the most

immature, that is the white pods were found to be on average considered HO (9.32). This phenomenon was not observed in any of the other market types. A steady increase in the average O/L ratio through the maturity stages was reported in the HO runner cultivar with the maximum in the most mature (black) pods (47.18). Changes in O/L ratio with increased maturity were most evident in Virginia-type samples with an average O/L of 2.48 in white pods to an average of 49.03 in black pods (Table 1). Virginia-type peanuts achieved average HO O/L ratios higher than the other market types.

Spanish and Valencia-type HO peanuts followed a similar trend moving from average O/L ratios of 2.11 and 1.36 in white pods to 23.9 and 24.6 in black pods, respectively. These types both reached average O/L ratios above the defined level of 9 at the third level of maturity (Orange A) but they never reached the levels of the Runner or the Virginia types. For the NO Spanish type, the O/L ratio was found to double from 0.64 (white pods) to 1.21 (black pods). The Valencia type were very similar, that is 0.64 in the white pods to 1.15 in the black pods. That these groupings of runners and Virginia types reached O/L ratios of levels twice that of the Spanish and Valencia types at maturity fits with the differences in their genetic heritages. Runner and Virginia types are of the subspecies *hypogaea* while Spanish and Valencia are of the subspecies *fastigiata* (Holbrook & Stalker, 2003).

The flavors associated with lipid oxidation have been reported to be the result of aldehydes and ketones derived from linoleic acid (Pattee, Singleton, & Johns, 1971; Wang, Adhikari, & Hung, 2017). These compounds result in flavors described as “cardboard” or “paint” in finished projects containing roasted peanuts. The reduction of linoleic acid in HO varieties is responsible for retarding or limiting the production of these objectionable flavors (O’Keefe et al, 1993). The size of peanut seeds has been associated with roasted peanut flavor and with certain distinct off flavors related to sugar levels in the seeds that change with seed maturation (Pattee, Pearson, Young & Giesbrecht, 1982). The final roast color is also influenced by peanut maturity (Sanders, Vercellotti, Crippen, & Civile, 1989). This would be a result of levels of free amino acids and sugars. These earlier studies were performed only on peanut varieties with normal oleic fatty acid profiles, as those were the only ones commercially available at that time. Although off flavors in roasted peanuts can be the result of peanut composition, curing practices, and/or storage conditions, knowledge of ways to control their onset is vital to the production of high-quality consumer products. When using peanuts of the high oleic varieties, producers should source the most mature seed possible regardless of the market type used.

5. Conclusion

The relationship between full maturity in the different market types and HO peanuts was established in this study. The data from this study shows that mixing can be present that is not necessarily the result of physical mixing or mishandling. While the size of the peanut pod is not an absolute determinate of the maturity or the fatty acid profile of the peanut seed inside, a rigorous sizing program will be advantageous to the final oil quality of peanuts especially with the larger seeded market types. This would help eliminate immature peanut seeds that are more easily susceptible to lipid oxidation resulting in unacceptable flavor experiences for consumers of products containing roasted peanuts. Careful attention to sorting peanuts for maturity as best as possible using sizing will add economic value to the peanut crop as well as ensure minimal exposure to oxidized lipids which could compromise the health of consumers.

Acknowledgments

The authors acknowledge technical assistance from Mr. James A. Schaefer and Ms. Rachel Johanningsmeier. The authors wish to thank Dr. Clyde Bogle and the staff of the North Carolina State University Peanut Belt Research Station in Lewistown, NC, USA for assistance in producing the Runner and Virginia peanuts; Dr. Kelly D. Chamberlin of the Wheat, Peanuts, and Other Field Crops Research Unit, USDA, ARS, Plains Area, Stillwater, OK, USA for providing the Spanish peanuts, and Dr. Naveen Puppala of New Mexico State University in Clovis, NM, USA for the gift of the Valencia peanuts;

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