What is the Effect of Roasting on the Texture of Whole Raw Almonds?

Impact of Almond Texture between Raw and Roasted Almonds Using the TA.XT Plus Texture Analyzer.

Project 2: Protocol
Texture

NUTR 405-06: Group 7
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Abstract

Introduction/Background

Textural components of food are significant to scientific research and analysis because it plays a role in the sensory attributes of eating. Understanding desired food preferences aids in product development. If one of the major sensory properties (appearance, texture, aroma, or taste) are undesirable, this will cause someone to reject eating the food item. In related literature, there is still an open discussion on whether or not sensory results should be correlated to instrumental data obtained under conditions that simulate oral breakdown (Varela et al., 2008).

The purpose of this study is to examine the textural property, specifically hardness, of two different types of almonds. Our research question is *what is the effect of roasting on the texture of whole raw almonds*? It is hypothesized that there will be a significant difference in the texture of raw vs roasted almonds based on previous comparisons with roast levels and the decrease of water activity in the roasting process (Contador et al., 2015, Chauvin et al., 2018). Almonds were chosen as the study material because crispness/crunchiness is a key factor in the sensory acceptability of this food item. The most common roasting system is the convection oven. This causes changes in appearance, texture and flavor, due to dehydration, browning, lipid oxidation and diverse structural changes (Varela et al., 2006). The degradation of the structure during roasting could cause changes in textural properties such as crispness, hardness (firmness), grittiness, porosity, and fracturability (Varela et al., 2006). Hardness (firmness) is an important textural property of foods, which will be the primary characteristic to observe in this study (Chen and Opara, 2013). Using textural measurements, the quality of almonds can be assessed to meet customer satisfaction. A study by Food Research International found that the texture perception generated by the breakdown of an almond, a dynamic process occurring in the mouth, was closely related to its acceptability (Varela et al., 2008). Oral digestion is the first step in which the physical characteristics of solid foods are subjected to changes because the size must be reduced before swallowing. The breakdown of a food during mastication is highly variable, depending on the food characteristics as well as the consumer eating it (Varela et al., 2008).

Study Design

In order to determine the effect of texture on roasted almonds, raw almonds will represent the control group, while the roasted almonds will be the experimental group. Four trials will be conducted for each group, with five samples per trial for a total of 40 samples. Twenty for the control group and twenty for the experimental group. After all data is collected and statistically analyzed, the final results of raw and roasted almond hardness in grams will be compared.

Subject (Sample) Selection and Randomization Method

Consideration for this study will include almonds of the same brand and must be unflavored and unsalted. Almonds are to be selected according to their size and shape to ensure minimum variation and consistent testing. Inclusion criteria are unsalted and unflavored with the following dimensions: length 20 $\pm$ 0.10 mm, width 14 $\pm$ 1.0 mm, height 7 $\pm$ 1.0 mm, and weight 1.2 $\pm$ 0.1 g. Exclusion criteria include defective almonds, such as chipped or halved, or overly roasted almonds that appear burnt. Upon completion of sample selection based on the inclusion/exclusion criteria, samples will be given a randomized sample number.

Materials/Methods

Materials needed for this study are whole raw peeled almonds, whole roasted almonds, and the TA.XT Plus Texture Analyzer. We will be using store bought Blue Diamond brand whole raw almonds, along with Blue Diamond brand whole roasted almonds. All of the samples will be stored in plastic airtight containers and placed in a refrigerator until the trials are run. Corresponding Texture Component software was used for testing and data recording. The texture analyzer is an instrument that measures force/displacement using a weighted force. First, we will calibrate the force and height of the instrument, before beginning the experiment trials.

The test will be done using a craft knife blade attached to the TA.XT Plus Texture Analyzer, and used to shear the almond at a given speed. The sharpness of the blade is important to shear the sample with precision without compressing the sample. Almond hardness will be determined by the maximum force on the graph recorded in the software. The value will correlate with the force required to shear the almond. Almond crunchiness is determined from the measurement of the quantity of fractures generated during the test.

Procedural Steps

First, we will attach the Craft Knife A/CKB blade to the instrument. This blade's sharpness and thickness enables precision cutting for small samples, such as nuts. Next, we will fix the fixture base table to the base of the instrument. We will then insert the base plate to the fixture base table and tighten it into position using the side screws. Next will be to position the fixture base table under the probe and then tighten the thumbscrews to prevent further movement. We will remove the sample from the plastic storage container and place it on the fixture base plate. After this we will lower the arm of the instrument so that the probe is a few millimeters above the sample and position the sample centrally under the craft knife. In order to produce reliable results, the sample orientation will be kept consistent throughout all tests performed. Once this alignment is complete, we will run the texture analyzer to do the test.

Schedule of Measurements

- ❑ Set-Up:
  - ❑ Ensure switch is on by flipping back switch to on position
  - ❑ Turn on computer and open exponent software
  - ❑ Close help screen
  - ❑ Begin calibration of instrument
- ❑ Calibration:
  - ❑ Attach probe to be used for experiment - Craft Knife A/CKB blade
  - ❑ Go to TA tab on top menu
  - ❑ Select calibrate, then calibrate force
  - ❑ Follow instructions on screen, then click next
  - ❑ Enter calibration weight value in grams
  - ❑ Place weight on calibration platform
  - ❑ Click next and wait until calibration is complete
  - ❑ When finished, click finish and remove weight
  - ❑ Go to TA tab and press calibrate, then calibrate height
  - ❑ PROBE height calibration screen will appear
  - ❑ Click okay

- ❏ Probe will be lowered until it touches the platform then come back up
- ❏ When calibration is complete, move on to the next step

Once sample is positioned

- ❏ Return to start
- ❏ Test mode: COMPRESSION FORCE (see Appendix A).
- ❏ Pre-Test speed: 1.00 mm/sec
- ❏ Test Speed: 3.00 mm/sec
- ❏ Post-test speed 10 mm/sec
- ❏ Target mode: DISTANCE
- ❏ DISTANCE 5.00 MM
- ❏ Trigger type: AUTO (FORCE)
- ❏ Trigger force: 50.00 g
- ❏ *RUN TEST*

Data Handling

Data will be collected on the Excel spreadsheet provided (see Appendix B). The Excel spreadsheet will include a separate table for raw almonds and roasted almonds. A section for issues will be included to record any mistakes the collector faces during the experiment. Each set of almonds will be given a sample identification at random (1a to 1e, 2a to 2e, 3a to 3e, 4a to 4e, and 5a to 5e). For each almond, maximum force (grams) shown on the Exponent software screen will be recorded, followed by the amount of firmness shown in grams. Once all raw data has been collected, formulas for average, standard deviation, and coefficient of variation will be input into Excel, then calculated.

Calculations are as follows (with *x* being the cell values to be used in the calculation):

Raw Almonds:

Force:

Average: =AVERAGE(*x:x*)

Standard Deviation: =STDEV.P(*x:x*)

Coefficient of Variation: =(SD/AVG)*100

Firmness:

Average: =AVERAGE(*x:x*)

Standard Deviation: =STDEV.P(*x:x*)

Coefficient of Variation: =(SD/AVG)*100

Roasted Almonds:

Force:

Average: =AVERAGE(*x:x*)

Standard Deviation: =STDEV.P(*x:x*)

Coefficient of Variation: =(SD/AVG)*100

Firmness:

Average: =AVERAGE(*x:x*)

Standard Deviation: =STDEV.P(*x:x*)

Coefficient of Variation: =(SD/AVG)*100

Upon calculating individual average, standard deviation, and coefficient of variation, values will be inputted into Table IV cells for comparison. A T-Test will then be used to compare the means of the control and experimental group for both force and firmness. Perform a T-test by clicking *formulas* > *functions* > *T-test*. Once the T-test screen appears, select samples 1a-4e of raw almond force for *Array1*, samples 1a-4e of roasted almond force for *Array2*, 1 for *Tails*, and 1 for *Type*. Repeat for firmness. A 1-tailed test will be used, but a 2-tailed test may be used to observe a difference in values. If performing a 2-tailed test, input 2 for *Tails*, and 2 for *Type*.

References

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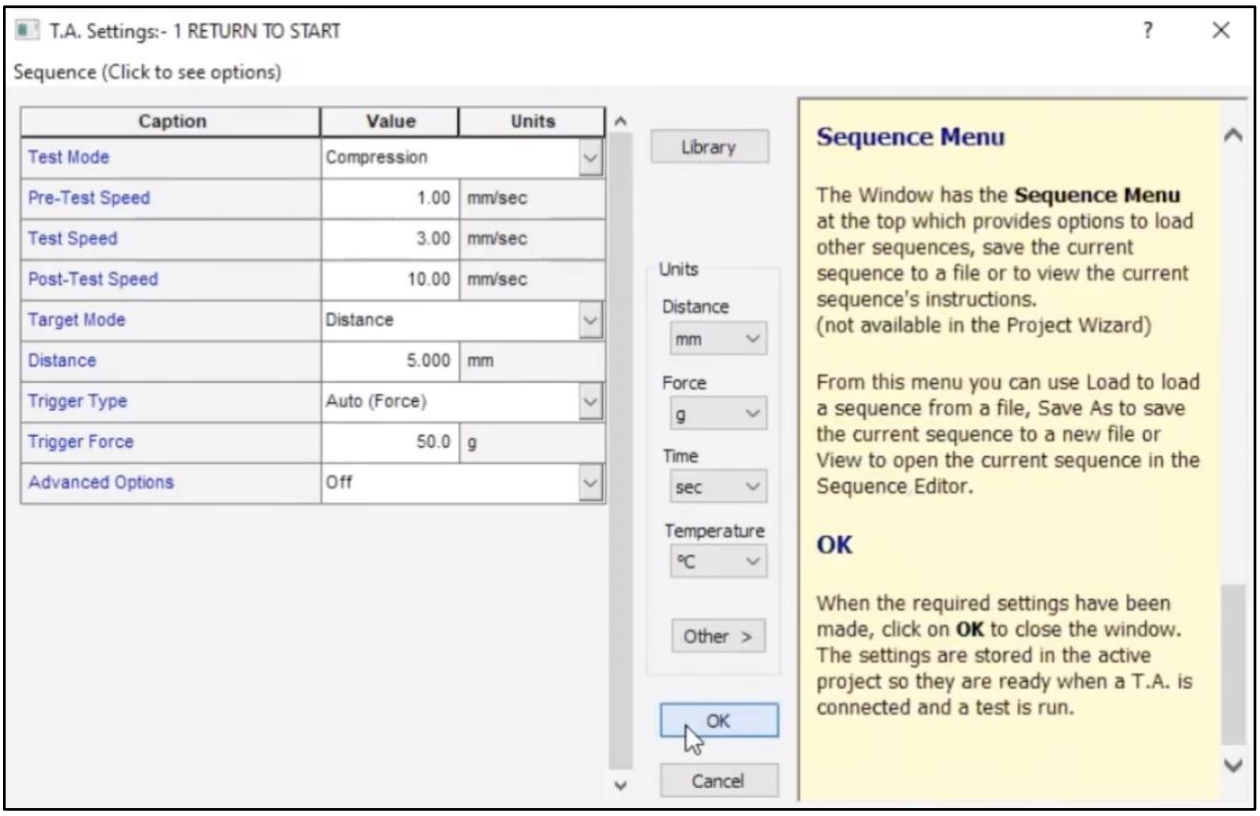
Chen L, Opara UL. Approaches to Analysis and Modeling Texture in Fresh and Processed Foods – A review. *Journal of Food Engineering*. 2015;119(3):497-237. Published 2013 Jun 27. Accessed: 2021 Mar 12. doi: 10.1016/j.jfoodeng.2013.06.028

Appendices

Appendix A: Exponent software values for compression force test mode to be used.



Appendix B: Sheet provided for data input. Includes tables for raw almonds, roasted almonds, issues, combined average table, T-test table, and notes. To be printed (first section) or directly input (second section).

Printed Sheet

Collector(s): _____

Date: _____

Table I.

Raw Almonds - Control Group Hardness - in grams (g)			
Sample	**Trial #**	**Force - (g)**	**Firmness - (g)**
1a	1		
1b	1		
1c	1		
1d	1		
1e	1		
2a	2		
2b	2		
2c	2		
2d	2		
2e	2		
3a	3		
3b	3		
3c	3		
3d	3		
3e	3		
4a	4		
4b	4		
4c	4		
4d	4		
4e	4		
	Average		
	SD		
	CV		

Table II.

Roasted Almonds - Experimental Group Hardness - in grams (g)			
Sample	**Trial #**	**Force - (g)**	**Firmness - (g)**
1a	1		
1b	1		
1c	1		
1d	1		
1e	1		
2a	2		
2b	2		
2c	2		
2d	2		
2e	2		
3a	3		
3b	3		
3c	3		
3d	3		
3e	3		
4a	4		
4b	4		
4c	4		
4d	4		
4e	4		
	Average		
	SD		
	CV		

Table III.

Issue(s):

Table IV.

	AVG	SD	CV
Raw Almonds			
Force			
Firmness			
Roasted Almonds			
Force			
Firmness			

Table V.

	Force	**Firmness**
T-Test		

Notes:	AVG:	Average
	SD:	Standard Deviation
	CV:	Coefficient of Variation

Direct Input

Collector(s):

Date:

Table I.

Raw Almonds - Control Group (Hardness - in grams)

Sample	Trial #	Force - (g)	Firmness - (g)
1a	1		
1b	1		
1c	1		
1d	1		
1e	1		
2a	2		
2b	2		
2c	2		
2d	2		
2e	2		
3a	3		
3b	3		
3c	3		
3d	3		
3e	3		
4a	4		
4b	4		
4c	4		
4d	4		
4e	4		
	Average		
	SD		
	CV		

Table II.

Roasted Almonds - Control Group (Hardness - in grams)

Sample	Trial #	Force - (g)	Firmness - (g)
1a	1		
1b	1		
1c	1		
1d	1		
1e	1		
2a	2		
2b	2		
2c	2		
2d	2		
2e	2		
3a	3		
3b	3		
3c	3		
3d	3		
3e	3		
4a	4		
4b	4		
4c	4		
4d	4		
4e	4		
	Average		
	SD		
	CV		

Table III.

Issues

Table IV.

	AVG	SD	CV
Raw Almonds			
Force			
Firmness			
Roasted Almonds			
Force			
Firmness			

Notes:	AVG:	*Average*
	SD:	*Standard Deviation*
	CV:	*Coefficient of Variation*

Table V.

	Force	Firmness
T-Test		