ACCEPTANCE OF RESVERATROL ASS PEANUTS (RRP)

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Trabajo de grado como parte de los requerimientos para la obtención del Título de Ingeniero de Alimentos

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OBJECTIVE: To evaluate through a sensory panel the acceptance of peanut treated under different conditions to increase the resveratrol content, the panelist evaluate 5 attributes color, overall flavor, roasted peanutty flavor, bitter taste and overall acceptances.

Resumen

El resveratrol es un compuesto bioactivo con capacidad antioxidante ampliamente estudiado por sus beneficios en la salud humana como: Quimiopreventivo contra el cáncer, Reduce el riesgo de enfermedades cardiovasculares y con potencial terapéutico en Alzheimer, Se ha identificado al maní como una fuente importante de resveratrol y otros compuestos fenolicos bioactivos. El resveratrol se encuentra abundantemente en el maní, cascara del maní, vino tinto y en la piel de la uva El maní se somete a tratamientos para que el resveratrol sea incrementado. El objetivo de este estudio es Evaluar mediante panel sensorial, la aceptación del maní sometido a diferentes tratamientos para incrementar el contenido de resveratrol. Un total de 60 panelistas fueron reclutados por medio de una base de datos del el laboratorio de análisis sensorial de la universidad de Georgia. Se evaluaron 9 muestras diferentes 8 con piel y 1 sin piel, se presenta el análisis de varianza para 5 de los atributos en una escala de 9 puntos hedónicos y en otra escala de 7 puntos hedónicos 4 de los atributos. En la escala de 9 puntos Runner médium control fue la muestra que mas le gusto a los jueces Runner médium US fue la menos aceptada por los jueces, en la escala de 7 puntos Runner Unshelled y Runner médium control la menos acpetada por los jueces y Spanish jumbo la mas aceptada por los jueces.

Palabras claves: resveratrol, compuestos bioactivos, enfermedades, maní, panel sensorial, panelistas, análisis sensorial, muestreo.

Abstract

The resveratrol is a bioactive compound with antioxidant capacity widely studied for its benefits on human health as: reduced cardiovascular disease and reduced cancer risk, peanut has been identified an important source of resveratrol and other bioactive phenolic compounds. Resveratrol is found most abundantly in peanuts, peanuts skin, red wine and grapes skins. The peanut was submitting to diferents treatments to increased the resveratrol. The objective of this study is evaluated through a sensory panel the acceptance of peanut under different treatments to increase the resveratrol content. A total of 60 consumers were recruited trough and existing consumer database of the Consumer Insight and Sensory Science laboratory established and maintained at the University of Georgia Griffin Campus. 9 different samples were evaluated 8 with skin on and 1 with skin off, we present the analysis of variance for five of the attributes in a scale of 9 hedonic points and in other scale of 7 hedonic point 4 attributes. In the scale of 9 points the Runner medium control was the sample most liked for the judges, Runner medium US treated was the sample less accepted by judges, In the scale of 7 points the Runner Unshelled and Runner medium control were the samples less accepted for the judges and the Spanish Jumbo was the sample that the judges most liked.

Keywords: resveratrol, bioactive compounds, diseases, peanuts, sensory panel, panelist, sensory analysis, sampling.

1. Introduction

In recent years, health has become a main preoccupation due to the increase in cardiovascular diseases, cancers, obesity, etc. Consumers have realized that functional components in food are an important consideration for a healthy lifestyle.[1]

[1] Déborah ANCEL, under the direction of Dr. Anna V. A. Resurreccion 2008 Comparative profiles and concentrations of phenolic compounds in UV and Ultrasound (US) treated peanut kernels.

Resveratrol is a naturally occurring antioxidant primarily found in plants as diverse as peanuts, grapes, and mulberries. Resveratrol, is also known as 3, 4', 5-trihydroxystilbene. [2]

The resveratrol has provoked an interest due to the association with reduced cardiovascular disease and reduced cancer risk,[3] probably due to its antioxidative and anti-proliferative activities[4]. Its has been identified as an effective candidate for cancer chemoprevention due its ability to block each step in the carcinogenesis process by inhibiting several molecular targets such as kinases, cyclooxygenases, ribonucleotide reductase, and DNA polymerases.[5]

The highest concentrations of resveratrol and other bioactive phenolic compounds in peanut and peanut products are found in the skins, boiled peanuts, and peanut stressed by ultrasound. The processing technologies, such as stress applications, and use of unblanched (with skins) and varying quality peanuts enhance concentrations of resveratrol and other bioactive compounds in peanuts.[6]

There are several food that contains resveratrol been Red wine is the most common food source, having 0.99-5.01 mg/L.[7] Trans-Resveratrol has also been identified in peanut kernels and processed peanut products. Roasted peanuts contain the lowest content of resveratrol, 0.055 (0.023 íg/g, peanut butter

[2] SAIN, Joseph. 1.Determination of Resveratrol in Peanuts by LC-TOFMS. USA. http://www.leco.com/resources/application_note_subs/pdf/separation_science/-269.pdf
[3] Jocelyn M. Sales, A.V.A. Resurreccion. Maximising resveratrol and piceid contents in UV and ultrasound treated peanuts. Food Chemistry 117 (2009a) 674–680.
[4] S.S. Lee a, S.M. Lee a, M. Kim b, J. Chun c, Y.K. Cheong d, J. Lee a. Analysis of trans-resveratrol in peanuts and peanut butters consumed in Korea. Food Research International 37 (2004) 247–251 ELSEVIER.
[5] Philipp Saiko a, Akos Szakmary b, Walter Jaeger c, Thomas Szekeres. Resveratrol and its analogs: Defense against cancer, coronarydisease and neurodegenerative maladies or just a fad?. Mutation Research 658 (2008) 68–94 ELSEVIER.
[6] Potrebko 2009 Plan of work THE BIOACTIVE POTENTIAL OF PEANUT PRODUCTS
[7] McMurtrey, K. D.; Minn, J.; Pobanz, K.; Schultz, T. P. Analysis of wines for resveratrol using direct injection high-pressure liquid chromatography with electrochemical detection. J. Agric. Food Chem. 1994, 42, 1997-2000.

contains a significantly higher amount, 0.324 (0.129 íg/g, and boiled peanuts have the highest concentration, 5.138 (2.849 íg/g)[8].

Rudolf and Resurreccion,[9] explored the effect of abiotic stressed, such as size reduction and subsequent UV or ultrasound (US) treatment, on resveratrol content in peanut kernels followed by incubation for one of 3 time periods. Their results demonstrated effective increase in resveratrol, from 0.48 µg/g to 3.42 µg/, in sliced (2mm) peanuts kernels the exposed to UV light (distance of 40 cm, 10 min and incubation of 48h); and from 0.48 µg/g to 3.96 µg/g after US treatment (power density of 39.2 mW/cm^3, 4 min and incubation of 36h). In a later study Rudolf and Resurreccion[10] optimized stress condition such as varying slicing thickness, from 2 to 6 mm, and incubating time, from 24 to 48 h, to produce the highest amount of resveratrol. The optimized area was bound by peanuts size of 8.9, 7.2 and 6.4 mm and incubating time of 48, 41.5 and 48 h. to produce the highest amount of resveratrol [11].

Peanut skins contain flavonoids such as epigallocatechin, epicatechin, catechin gallate and epicatechin gallate[12]; proanthocyanidins including procyanidin B[13], A-type and B-type procyanidin dimers, trimers and tetramers[14]; phenolic acids such chlorogenic-, coumaric-, caffeic- and ferulic- acids[15]; and stilbenes, *trans*-resveratrol[16].

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[8] Sobolev, V. S.; Cole, R. J. trans-Resveratrol content in commercial peanuts and peanut products. J. Agric. Food Chem. 1999, 47, 1435-1439.

[9] Rudolf, J.R; Resurreccion A.V.A. Elicitation of resveratrol in peanut kernel by application of abiotic stresses. J Agric food chem.. 2005, 53, 10186-10192.

[10] Rudolf, J.L; Resurreccion, A.V.A. Optimization of trans-resveratrol concentration and sensory properties of peanut kernel by slicing and ultrasound treatment, using response surface methodology. J.Food Sci. 2007, 72 S450-S462.

[11] Potrebko and Resurreccion. The effect of UV doses in Combined UV-Ultrasound Treatment on Resveratrol and Pieced content in Sliced Peanut Kernels. Food chemistry.

[12] Yu, J., Ahmedna, M., & Goktepe, I. (2005a). Effects of processing methods and extraction solvents on concentration and antioxidant activity of peanut skin phenolics. Food Chemistry, 561 90, 199-206.

[13] Lou, H., Yuan, H., Ma, B., Ren, D., Ji, M. & Oka, S. 2004. Polyphenols from peanut skins and their free radical-scavenging effects. Phytochemistry, 65, 2391-2399.

[14] Yu, J., Ahmedna, M., Goktepe , I., & Dai, J. (2006). Peanut skin procyanidins: composition and antioxidant activities as affected by processing. Journal of Food Composition and Analysis, 19, 564 364-371.

[15] Yu, J., Ahmedna, M., & Goktepe, I. (2005b). Effects of processing methods and extraction solvents on concentration and antioxidant activity of peanut skin phenolics. Food Chemistry, 561 90, 199-206.

Peanut kernels contain caffeic-, ferulic- and coumaric- acids[17] , and stilbenes, *trans*-resveratrol and its glucoside, *trans*-piceid[1819].

The sensory evaluation is a discipline scientific used to evoke, measure and analyze characteristics of the food reactions perceived through the organs of the senses (tact, taste, view, smell, ear). The sensory analysis comprises a set of techniques for precise measurement of human responses to food and provides useful information for product development for food technologists and companies.

Resurreccion and sales in a consumer sensory overall acceptance (OA) of UV and US treated peanuts showed that regardless of treatment, UV treated peanuts had higher ($a < 0.05$) mean OA rating of 5.7 ± 1.7, range: 5.0 ± 1.7 to 6.3 ± 1.5, compared to US treated peanuts with 5.1 ± 1.6, range: 4.2 ± 2.5 to 6.0 ± 1.8. All UV or US treated peanuts, however, had lower ($a < 0.05$)[20] OA ratings than controls with 7.4 ± 1.4. The higher OA ratings obtained in UV compared to US treated samples were unexpected since UV exposure is known to enhance off-flavour development in food due to lipid peroxidation[21].

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[16] Francisco, M. L. dL. & Resurreccion, A.V.A. (2009). Development of a reversed phase high performance liquid chromatography (RP-HPLC) procedure for the simultaneous determination of phenolic compounds in peanut skin extracts. *Food Chemistry, 117,* 356-363

[17] Mattila, P., & Hellström, J. (2007). Phenolic acids in potatoes, vegetables, and some of their products. Journal of Food Composition and Analysis, 20, 152-160.

[18] bern-Gómez, M., Roig- Pérez, S., Lamuela-Raventós, R. M. & de la Torre-Boronat, M. C.(2000). Resveratrol and piceid levels in natural and blended peanut butters. Journal of Agricultural and Food Chemistry, 48, 6352-6354.

[19] Sales, J. M., & Resurreccion, A. V. A. (2009b). Maximizing resveratrol and piceid contents in UV and ultrasound treated peanuts and ultrasound treated peanuts. Food Chemistry, 117, 674-680.

[20] Sales, J. M., & Resurreccion, A. V. A. (2009c). Maximizing resveratrol and piceid contents in UV and ultrasound treated peanuts and ultrasound treated peanuts. Food Chemistry, 117, 674-680.

[21] Duh, P. D., & Yen, G. C. (1995). Changes in antioxidant activity and components of methanolic extracts of peanut hulls irradiated with ultraviolet light. Food Chemistry, 54, 127–131.

2. Material and method

A total of 60 consumers were recruited trough and existing consumer database of the Consumer Insight and Sensory Science laboratory, established and maintained at the University of Georgia Griffin Campus. Additional recruitment methods included Internet advertisement, intercept and flyers posted at community centers, grocery store and other business established. Fifty responders were recruited for the study[22] and additional 10 alternates were recruited to use in case of now shows.

The following recruitment criteria were used:

(1) Ages 18-70, (2) Not allergic to roasted peanuts and peanut products, (3) must like and consume peanuts and peanut products at least twice a week.. In addition, a demographic characteristic of the panel was matched according to those in US census, 2008, by US Census Bureau, US Department of Commerce, Economics and Statistics Administration.

A recruiter telephoned each potential consumer panelist from the database and interviewed them according to a recruitment screener. Potential panelists were qualified on the recruitment criteria for the study. Recruiters keyed-in consumers' responses to each question on the screener. Qualified panelists were signed up for sessions in which they were able to participate. The recruiter verified consumers' mailing and e-mail addresses, telephone numbers and made necessary corrections.

[22] Resurreccion, A. V. A. (1998). Consumer sensory testing for product development. Gaithersburg, MA, USA: Aspen Publishers, Inc.

2.1 Table 1. Samples to be tested

A total of nine samples were tested as is shown in table 1. Additionally there were 2 reps for each treatment, for a total of 18 sample

Sample #	Peanut type	Skin on	Skin off
1	Runner medium, roasted	X	
2	Virginia medium, roasted	X	
3	Spanish jumbo, roasted	X	
4	Runner stressed, roasted	X	
5	Runner #1, roasted	X	
6	Mil Run, roasted	X	
7	Runner med ultrasound (US) treated,	X	
8	roasted	X	
9	Ru Unshelled, boiled		X
	Runner medium CONTROL, roasted		

There were 2 reps for each treatment, for a total of 18 samples

2.2.Estimates of the amount of peanuts for the test

Each panelist was provided with 15 grams of paste served in a 1 oz cups , for a total of 1.8 kg per replication. All the peanuts were roasted, except for boiled peanuts, and milled into a paste.

2.3 Sample preparation

<u>2.3.1 Raw peanuts before roasting</u>

4 kg for Runner medium, Virginia medium, Spanish jumbo, Runner stressed, Mil Run, Runner #1 peanuts were sorted, packaged into pre-labeled plastic bags and stored -4oC then divided into 2 process reps, each rep was roasted or boiled miller as above.

2.3.2. <u>Boiling</u>

The 4 kg of Runner unshelled sorted peanuts were washed in a colander thoroughly (2 mm holes, 5 kg capacity) with cold water until water run clear. Then washed peanuts (4 kg) were soaked in a 10 L plastic tub in 8000 mL cold

tap water (1:2 weigh peanuts/volume water) for approximately 30 minutes. After drainage the peanuts were divided into 2 Kg batches and boiled; each batch of peanuts was placed in a pot with 3L of water and 304.5 g of salt. The peanuts were cooked covered with a lid, on high heat until boiling. Then heat was reduced to medium and the peanuts were cooked for 4 hours with occasionally stirring until the desired texture was obtained, similar to that of cook beans. The evaporated water was replaced with hot tap water.

The boiled peanuts were drained and cooled in a colander for 30 min. The cooled peanuts were unshelled, packaged and stored at -4oC until blended for the sensory test.

2.3.3. US treatment of Runners medium

Sanitizing equipment

All equipment, materials and instruments (Kitchen knives, plastic or glass containers, plastic tub, plastic chopping boards, gloves, Mason glass jars, metal colander and glass beakers) were sanitized with 200ppm of chlorine solution for 15 min.

Sanitizing peanuts

Raw and sorted Runners medium peanuts (4 kg) were washed in a colander (2mm holes, 5 Kg capacity), which was immersed into a 20 L capacity plastic tub filled with 9 L of tap water (1:2 weight of peanuts/volume of water). The peanuts were washed 2 times 30 sec by swirling with continuous movements with hands in sanitized gloves to remove adhering dirt and foreign materials. Then peanuts were drained in the same colander.

The washed peanuts were soaked in a 10 L capacity plastic tub containing 4 L of 100 ppm chlorinated water (1:1 weigh of peanuts/volume of 100 ppm chlorine solution) for 15 min..

The peanuts were rinsed twice in a sterile colander with 4 L of deionized water filtered through 0.2 um nylon filter (Millipore corporation Bedford, MA) to wash away chlorinated water (1:1 weigh of peanuts/volume of sterilized water).

Important: All procedure was conducted under yellow light to prevent isomerization of resveratrol[23].

Peanut imbibitions

The sanitized peanuts were placed into a 10 L capacity plastic tub, sanitized in 200 ppm of chlorine solution and soaked for 16 h in 4 L of sterilized water (1:1 weigh of peanuts/volume of water) to reach maximum water holding capacity. All the procedure was done under the yellow light.

Stress application by wounding peanuts by slicing

Fully imbibed peanut kernels were drained for 15 min and cut in half in the middle of the kernel widthwise to approximately 7 mm using a sanitized X-ACTO 11 mm diameter x 126 mm long with 0.6 mm stick blade and 49 wide, on a sanitized plastic chopping board. The sliced peanuts were mixed in a bowl and then divided into batches of approximately 400 g for subsequent sonication.

The procedure is performed under yellow light.

Stress application by Ultrasound

Fully imbibed sliced peanut kernels, 400 g were placed into a 1 L graduated glass beaker, which was filled with sterile water to cover the peanuts up to the 750 ml, then sonicated using an ultrasonic processor, (Model CPX 500, Cole Parmer Instruments, Vernon Hills, IL). Ultrasound at 20 kHz was applied with a 25 mm diameter probe operating continuously at ambient temperature of 25^{o}C set at 51% amplitude to achieve an ultrasound power density of 80mW/cm^{3} for 6 minutes. After sonication the peanuts were transferred to a sanitized colander

[23] Trela, B.C. and Waterhouse, A.L. (1996). Resveratrol: isomeric molar absorptivities and stability. *Journal of Agricultural and Food Chemistry*, 44, 1253-1257.

to drain excess water for 15 min. All batches of sonicated peanuts were placed in one sanitized bowl and mixed.

The procedure was done under yellow light.

Incubation

All the sonicated peanuts were placed into sanitized Mason jars (Ball Corporation, Muncie, IN), with no lids wrapped completely with aluminum foil including the jar then incubating for 36 h at 25°C in a chamber for incubation (Precision scientific Mechanical convection incubating model 4 EM Chicago. Illion)

Drying

Incubated peanuts were placed into perforated aluminum trays (50 cm x 50 cm, 2 mm holes) and dried at 40°C for 24 h in a mechanical convection oven (Model 645, Precision Scientific, Winchester, VA).

Roasting

All the raw peanuts were roasted in impingement oven (Lincoln Model 1452, Fort Wayne, IN, USA) at 177°C for 15 min to and endpoint of 50 $\pm$.1[24] using a Colorimeter (Model 45/0 hunterlab, Reston VA).

2.3.4 Blending

Roasted peanuts were blending in equipment for peanuts butter specialty foods and equipment east long meadow MA 01028 capacity 500 g

[24] Lee, C.M. and. Resurreccion, A.V.A. (2006). Consumer acceptance of roasted peanuts affected by storage temperature and humidity conditions. LWT - *Food Science and Technology*, 39(8): 872-882.

After blending the samples were placed into glass Mason jars (Ball Corporation, Muncie, IN), put in a box to prevent the izomeration of the Resveratrol and stored in a cooler at -4°C until the test.

2.4 Consumer test

2.4.1. Test location

The consumer acceptance test of peanuts was conducted at the sensory laboratory of the Department of Food Science and Technology, GA Experiment Station, Griffin, GA 30223.

2.4.2. Conduct of tests:

On the test day consumers came to the reception area (Room 112) by following the signs, then signed-in for the test in the sign-in sheet, and verified their telephone numbers. The person in charge of the welcome, greeted consumers, gave them their folder and asked them to sign two consent forms. The greeter asked each consumer "Are you allergic to peanuts?" If consumer's answer was "No", the greeter wrote down 'none', and then initialed his or her name next to the answer on the consent form. In case of positive reply, consumers with allergy to peanuts were told that he/she couldn't participate in the test and the project leader was informed immediately.

Panelists evaluated samples in partitioned booths under environmentally controlled conditions and recorded their answers on a computerized ballot designed using sensory evaluation software Compusense Five (version 5.8, Compusense, Inc., Guelph, Canada) or a paper ballot for panelists, upon request. Samples were presented to panelists in a balanced sequential monadic order in a pre-labeled 1 oz. sample cup containing approximately 15g of roasted peanut paste on a serving plate.

2.4.3. Ballot

Consumers recorded their answers on computer ballots. Consumers evaluated samples for color, overall flavor, roasted peanutty flavor, bitter taste , overall acceptance, using 9-point hedonic rating scale: 1= dislike extremely, 2=dislike

very much, 3=dislike moderately, 4= dislike slightly, 5= neither like nor dislike, 6= like slightly, 7= like moderately, 8= like very much, 9= like extremely. Consumer rated color, overall flavor, roasted peanutty flavor, bitter taste rating using a Just-about-right (JAR) rating scale using 7-point category: 1=Much too weak, 4= Just-about-Right, 7=Much too strong. (Appendix 1).

First, they were instructed to look at the sample to rate color. Second they were asked to put 1/4 of sample in their mouth to evaluate overall flavor .Then they were asked to put 1/4 of the sample to evaluate roasted peanutty flavor and bitter taste, using hedonic rating scale. Then they were asked to look at the sample to rate color using JAR scale , after they were asked to put 1/4 of sample in their mouth for evaluate overall flavor, then they were asked to put 1/4 to evaluated roasted peanutty flavor and bitter taste also using JAR scale, finallythey evaluated to rate overall acceptance flavor. Crackers and water were used as palate cleansers between samples.

Panelists filled out the demographic questionnaire during the second break and finally after the test they returned to the greeting room to receive their honoraria.

2.4.3. Statistical analysis

Sensory evaluation software Compusense Five (version 5.8, Compusense, Inc., Guelph, Canada) was used to evlauted the 5 attributes.

3. Results and discussion

Table 2. Present the analysis of variance for the attributes of color, overall flavor, roasted peanutty flavor, bitter taste and overall acceptances. This table shows as the above variables are statistically significant ($p<0.05$) between the samples tested. According to the coefficient of determination bitter taste test was the most difficult to evaluate by the judges. To see which samples show significant differences or no show significant difference was use the technique of multiple intervals of Tukey.

Table 2. Analysis of Variance (9-point hedonic rating scale)

Variable	Source of variation	D.F.	Sum of Squares	Mean of Squares	F Value	p-value	R^2
Color	**Samples**	17	688.059	40.474	15.49	0.0000	47,13
	Judges	49	1251.472	25.540			
	Error	833	2176.108	2.612			
	Total	899	4115.639	4.578			
Overall flavor	**Samples**	17	986.726	58.043	19.73	0.0000	45,00
	Judges	49	1017.823	20.772			
	Error	833	2449.997	2.941			
	Total	899	4454.546	4.955			
Roasted peanutty flavor	**Samples**	17	987.849	58.109	21.97	0.0000	47,04
	Judges	49	969.196	19.780			
	Error	833	2203.484	2.645			
	Total	899	4160.529	4.628			
Bitter taste	**Samples**	17	501.250	29.485	11.78	0.0000	40,98
	Judges	49	946.890	19.324			
	Error	833	2085.250	2.503			
	Total	899	3533.390	3.930			
Overall acceptance	**Samples**	17	915.702	53.865	18.25	0.0000	44,81
	Judges	49	1080.627	22.054			
	Error	833	2458.853	2.952			
	Total	899	4455.182	4.956			

3.1 Color

Runner medium control was the attribute that has the highest rating and is significantly different from the other samples. The sample Runner Unshelled

presented the lowest score statistically different from the other samples. In this attribute the judges were able to relate the samples. (table 1)

3.2 Overall flavor and Roasted peanutty flavor

In this attributes Runner medium US and Runner Unshelled do not present Statistical differences and its rating was the lowest, Runner medium control present the highest score being statistically different from the other samples.

3.3 Bitter taste

In the bitter taste the sample Runner medium control present the highest score being statistically different from the other samples otherwise happens with the sample Runner medium US not present statistical differences among the other sample this attribute was the most difficult for judges to evaluate.

Table 3. Multiple comparisons “Tukey” (9-point hedonic rating scale).

Color			OVERALL FLAVOR			Roasted peanutty flavor			Bitter taste		
Sample	Mmmean		Sample	Mean		Sample	Mean		Sample	Mean	
9 – 948	6.44	a	9 – 948	5.76	a	9 – 948	6.14	a	9 – 948	5.36	A
18 – 570	6.22	a	6 – 120	5.52	ab	6 – 120	6.02	ab	6 – 120	5.12	Ab
7 – 793	5.32	ab	18 - 570	5.50	ab	4 – 651	5.90	abc	15 – 746	4.94	Abc
6 – 120	4.94	b	13 - 237	5.18	abc	18 - 570	5.78	abc	13 – 237	4.90	Abc
5 – 867	4.84	b	15 - 746	5.10	abc	13 - 237	5.74	abc	18 – 570	4.80	Abc
4 – 651	4.80	b	4 – 651	5.04	abc	15 - 746	5.64	abc	1 – 285	4.78	Abc
2 – 302	4.78	b	12 - 689	4.90	abc	1 – 285	5.50	abc	4 – 651	4.66	Abc
1 – 285	4.76	b	1 – 285	4.88	abc	12 - 689	5.40	abc	5 – 867	4.56	Abc
15 – 746	4.74	b	5 – 867	4.66	abc	14 - 394	5.20	abc	12 – 689	4.26	Abcd
16 – 108	4.66	b	14 - 394	4.52	bc	5 – 867	5.12	abc	14 – 394	4.26	Abcd
13 – 237	4.64	b	2 – 302	4.50	bc	2 – 302	5.00	abc	2 – 302	4.22	Bcd
11 – 815	4.56	b	3 – 534	4.50	bc	11 - 815	4.98	bc	10 – 460	4.16	Bcd
14 – 394	4.56	b	10 - 460	4.46	bc	10 - 460	4.80	c	3 – 534	4.14	Bcd
12 – 689	4.44	b	11 - 815	4.20	c	3 – 534	4.78	c	11 – 815	3.86	Cde
10 – 460	4.36	b	8 – 419	2.82	d	7 – 793	3.18	d	17 – 923	3.30	De
3 – 534	4.34	b	17 - 923	2.66	d	16 - 108	3.18	d	8 – 419	3.14	De
8 – 419	2.80	c	16 - 108	2.46	d	8 – 419	3.08	d	7 – 793	2.92	E
17 – 923	2.70	c	7 – 793	2.40	d	17 - 923	2.92	d	16 – 108	2.76	E

Tukey's HSD (5% Significance Level)

3.4 Overall flavor

Runner medium US not present statistical differences and its rating was the lowest, Runner medium control present the highest score being statistically different from the other samples

Table 4. Multiple comparisons “Tukey” (9-point hedonic rating scale).

OVERALL ACCEPTANCE		
Sample	Mean	Groups homogeneous
9 – 948	5.64	A
6 – 120	5.38	Ab
18 – 570	5.20	Ab
13 – 237	5.14	Ab
4 – 651	5.12	Ab
1 – 285	5.06	Ab
15 – 746	5.00	Ab
5 – 867	4.56	Ab
3 – 534	4.40	B
2 – 302	4.32	B
12 – 689	4.32	B
14 – 394	4.30	B
10 – 460	4.20	B
11 – 815	4.16	B
8 – 419	2.88	C
17 – 923	2.62	C
7 – 793	2.48	C
16 – 108	2.34	C

Tukey's HSD (5% Significance Level)

Table 5 Present the analysis of variance for the attributes of color, overall flavor, roasted peanutty flavor and bitter taste. This table shows as the above variables are statistically significant ($p<0.05$) between the samples tested. According to the coefficient of determination overall flavor was the most difficult to evaluate by the judges, being the color the opposite.

Table 5. Analysis of Variance (7-point hedonic rating scale)

Variable	Fuentes de variation	D.F.	Sum of Squares	Mean of Squares	F Value	p-value	R^2
Color	**Samples**	17	722.832	42.520	42.84	0.0000	61,74
	Judges	49	611.361	12.477			
	Error	833	826.779	0.993			
	Total	899	2160.972	2.404			
Overall flavor	**Samples**	17	104.410	6.142	2.97	0.0001	35,70
	Judges	49	853.023	17.409			
	Error	833	1724.757	2.071			
	Total	899	2682.190	2.984			
Roasted peanutty flavor	**Samples**	17	235.952	13.880	8.60	0.0000	41,88
	Judges	49	732.806	14.955			
	Error	833	1344.214	1.614			
	Total	899	2312.972	2.573			
Bitter taste	**Samples**	17	74.126	4.360	2.71	0.0002	41,15
	Judges	49	864.121	17.635			
	Error	833	1341.819	1.611			
	Total	899	2280.066	2.536			

3.4 Color

With respect to the color the samples Runner Unshelled do not present significant differences being the lower rating. Spanish Jumbo was the highest rating being statistically different to the other samples, the color was easier evaluate for judges.

3.4 Overall flavor

In this attribute Spanish Jumbo was statistically different from the other samples being the highest rating, the sample Runner medium control present statistical differences and was the lowest rating.

3.5 *Roasted peanutty flavor*

Virginia medium was the highest rating, statistically different from the other samples, Runner Unshelled not present significant differences being the lowest rating.

3.5 Bitter taste

In this attribute Runner medium US had the highest rating and was statistically different from the other samples, the sample Runner medium control was statistically different from the other samples being the lowest rating.

Table 6 Multiple comparisons "Tukey" (7-point hedonic rating scale).

Color			OVERALL FLAVOR			Roasted peanutty flavor			Bitter taste		
Sample	Mean		Sample	Mean		Sample	Mean		Sample	Mean	
12 – 689	5.10	a	**12 - 689**	5.00	a	**2 - 302**	4.70	a	**16 - 108**	5.14	a
10 – 460	5.06	ab	**5 - 867**	4.82	a	**5 - 867**	4.70	a	**14 - 394**	4.86	ab
2 – 302	4.96	ab	**11 - 815**	4.80	a	**3 - 534**	4.58	a	**5 – 867**	4.80	ab
3 – 534	4.94	abc	**2 - 302**	4.78	a	**12 - 689**	4.54	a	**7 – 793**	4.80	ab
14 – 394	4.94	abc	**10 - 460**	4.78	a	**10 - 460**	4.50	a	**3 – 534**	4.74	ab
5 – 867	4.88	abc	**14 - 394**	4.74	a	**14 - 394**	4.50	a	**2 – 302**	4.70	ab
11 – 815	4.88	abc	**16 - 108**	4.62	a	**1 - 285**	4.38	a	**11 - 815**	4.70	ab
13 – 237	4.86	abc	**3 - 534**	4.54	ab	**11 - 815**	4.38	a	**8 – 419**	4.62	ab
15 – 746	4.76	abc	**9 - 948**	4.48	ab	**6 - 120**	4.36	a	**10 - 460**	4.58	ab
1 – 285	4.74	abc	**4 - 651**	4.46	ab	**4 - 651**	4.30	a	**12 - 689**	4.56	ab
4 – 651	4.74	abc	**1 - 285**	4.40	ab	**9 - 948**	4.28	a	**15 - 746**	4.50	ab
16 – 108	4.46	abcd	**7 - 793**	4.40	ab	**15 - 746**	4.28	a	**4 – 651**	4.42	ab
6 – 120	4.40	abcd	**6 - 120**	4.34	ab	**13 - 237**	4.16	a	**13 - 237**	4.36	ab
7 – 793	4.38	bcd	**13 - 237**	4.28	ab	**18 - 570**	4.14	ab	**9 – 948**	4.24	ab
9 – 948	4.24	cd	**15 - 746**	4.26	ab	**7 - 793**	4.10	ab	**17 - 923**	4.20	b
18 – 570	3.92	d	**8 - 419**	4.24	ab	**16 - 108**	4.00	ab	**6 – 120**	4.16	b
8 – 419	2.10	e	**18 - 570**	4.00	ab	**8 - 419**	3.24	bc	**18 - 570**	4.12	b
17 – 923	1.94	e	**17 - 923**	3.52	b	**17 - 923**	2.56	c	**1 – 285**	4.08	b

Tukey's HSD (5% Significance Level)

4. Conclusion

In the scale of 9 points the Runner medium control was the sample most liked for the judges, Runner medium US was the sample less accepted by judges. The bitter taste was the attribute most difficult to evaluate and to relate the samples by the judges, the color in the 2 scale was the easier to evaluate. In the scale of 7 points the Runner Unshelled were the samples less accepted for

the judges and the Spanish Jumbo was the sample that the judges most liked, the overall flavor was the most difficult to evaluated.

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Appendix 1

Sample _____ **Panelist code_____**

Ballot
Resveratrol enhanced peanuts

1. Please look at sample, then answer the following questions. Mark the box that best describes your feeling about the COLOR of this sample.

dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

2. Now, put 1/4 of sample in your mouth then answer the following question. Mark the box that best describes your feeling about the OVERALL FLAVOR of this sample.

dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

3. Please put 1/4 of sample in your mouth click the box to see the rating scale that best describes ROASTED PEANUTTY FLAVOR TASTE of this sample.

dislike extremely | dislike very much | dislike moderately | dislike slightly | neither like nor dislike | like slightly | like moderately | like very much | like extremely

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

4. How would you rate the BITTER TASTE of this sample?

dislike extremely | dislike very | dislike moderately | dislike slightly | neither like nor | like slightly | like moderately | like very | like extremely

moderately very extremely
much dislike
much

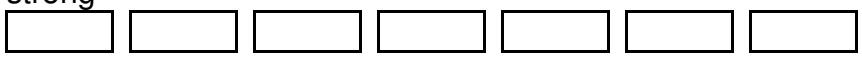
Now you are now ready to evaluate the sample using a different scale ranges from 'Much too weak (left)' to 'Much too strong (right)' with 'Just-about-right at the middle.

Note that the choices on this scale are diferent from the previous liking scale.

Do not evaluate liking.

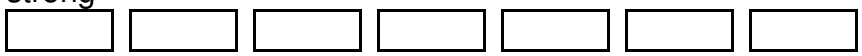
4. Please look at sample, then answer the following questions. Mark the box that best describes your rating about the COLOR of this sample.

Much too Just-about-
Much too
weak right
strong



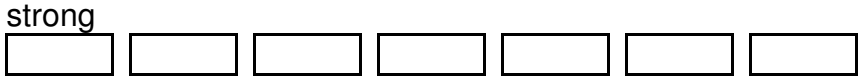
5. Now, put 1/4 of sample in your mouth then answer the following question. Mark the box that best describes your rating about the OVERALL FLAVOR of this sample.

Much too Just-about-
Much too
weak right
strong



6. Now, put all of the remaining sample in your mouth, then answer the next set of questions. Mark the box that best describes your rating about the relative ROASTED PEANUTTY FLAVOR ?

Much too Just-about-
Much too
weak right
strong



7. How would you rate the relative BITTER TASTE of this sample?

Much too Just-about- Much too
weak right strong

Finally, we want to know your OVERALL FEELING about the sample. Please tell us how much you liked or disliked the sample, using the scale from 'Dislike extremely (left)' to 'Like extremely (right)'.

8. Mark the box that best describes your feeling about the OVERALL ACCEPTANCE of this sample.

dislike extremely	dislike very much	dislike moderately	dislike slightly	neither like nor dislike	like slightly	like moderately much