

Sensory perspectives of the consumption of chips-type snacks made from black bean (*Phaseolus vulgaris* L) and peanut (*Arachis hypogaea* Linn) flours by university students in the Toluca Valley

Robledo-Ramírez, L.H.¹; Bautista-Mora, G.N.¹; Domingo-Gonzales, A.K.¹; Flores-Rodríguez, M.L.¹; Ramírez-Peñaloza, S.¹; Cruz-Monterrosa, R.G.²; González-Martínez, A.J.³; Martínez-Arellano, I.⁴; Álvarez-Cisneros, Y.M.^{5*}

- ¹ Licenciatura en Ciencia y Tecnología de Alimentos. División de Ciencias Biológicas y de la Salud. Universidad Autónoma Metropolitana Unidad Lerma. Av. De las Garzas 10. Col. El Panteón, Lerma de Villada, Estado de México. C. P. 52005.
 - ² Departamento de Ciencias de la Alimentación, División de Ciencias Biológicas y de la Salud. Universidad Autónoma Metropolitana, Unidad Lerma. Av. de las Garzas No. 10, Col. El Panteón, Municipio Lerma de Villada, Estado de México, C.P. 52005.
 - ³ Oficina de Planeación e Información Institucional, Rectoría de Unidad. Universidad Autónoma Metropolitana, Unidad Lerma. Av. de las Garzas No. 10, Col. El Panteón, Municipio Lerma de Villada, Estado de México, C.P. 52005.
 - ⁴ Instituto de Ciencias Aplicadas y Tecnología, Universidad Nacional Autónoma de México, Circuito Exterior S/N, Ciudad Universitaria, 04510, Ciudad de México, México.
 - ⁵ Departamento de Biotecnología, Universidad Autónoma Metropolitana, Unidad Iztapalapa, Av. Ferrocarril de San Rafael Atlixco 186, Col. Leyes de Reforma, 1^a. Sección. Alcaldía Iztapalapa. C.P. 09310, Ciudad de México, México.
- * Correspondence: acym@xanum.uam.mx

Citation: Robledo-Ramírez, L.H., Bautista-Mora, G.N., Domingo-Gonzales, A.K., Flores-Rodríguez, M.L., Ramírez-Peñaloza, S., Cruz-Monterrosa, R.G., González-Martínez, A.J., Martínez-Arellano, I., & Álvarez-Cisneros, Y.M. (2022). Sensory perspectives of the consumption of chips-type snacks made from black bean (*Phaseolus vulgaris* L) and peanut (*Arachis hypogaea* Linn) flours by university students in the Toluca Valley. *Agro Productividad*. <https://doi.org/10.32854/agrop.v15i8.2365>

Academic Editors: Jorge Cadena Iñiguez and Libia Iris Trejo Téllez

Received: April 24, 2022.

Accepted: July 23, 2022.

Published on-line: August 31, 2022.

Agro Productividad, 15(8). August. 2022. pp: 147-156.

This work is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International license.



ABSTRACT

Objective: The objective of this study is to evaluate the sensory perspectives of chips-type snacks made from black bean dry (*Phaseolus vulgaris* L) and peanut (*Arachis hypogaea* Linn) flours in a university population.

Design/methodology/approach: Two formulations were realized from peanut and black bean previously toasted and milled: 1) (PF) 50% peanut flour, 12.5% rice flour and 12.5 % cornstarch; 2) (BbF) 50% black bean flour, 12.5% wheat flour and 12.5% cornstarch. Each mixture of flours was extruded and fried until obtained chips-type snacks. A statistical-descriptive study was carried out from the observation of the eating habits of university students in the State of Mexico. On other hand, an affective test was tested to evaluate the acceptance of chips-type snacks made with PF and BbF in the categories of odor, taste, hardness, and easy to break.

Findings/conclusion: According to the questionnaire, the female gender has higher snack consumption than the male population. On another hand, potato chips are in third place as the most consumed snacks for women they preferred to consume them in their houses. Peanut and chickpea flour are the most preferred by the female population. There was no significant difference ($p > 0.05$) between the snacks prepared with PF and BbF, but 60% of the consumer accepted both snacks. It is concluded that the chips-type snacks made with different formulations could be a healthy alternative for the students, also it kind of products have good acceptability. Finally knowing the sensory perspectives could provide important information for developing healthier and easier-to-eat snacks.

Limitations on study/implications: More studies about the characterization of the chips-type snacks are required, also a mix of both legumes could be realized.

Keywords: bean, peanut, chips, snacks, sensory perspectives.

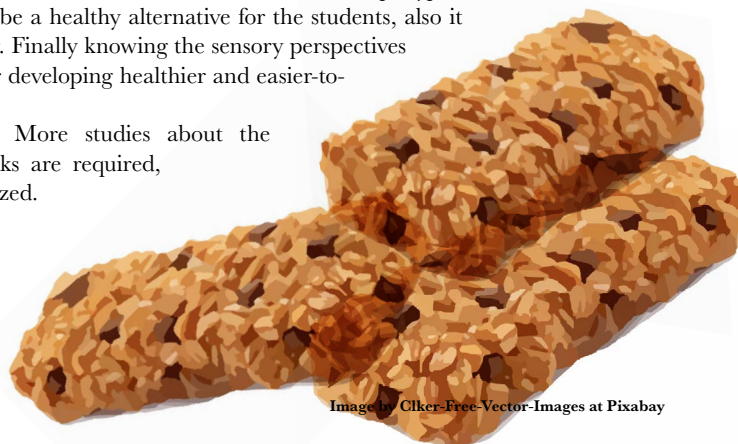


Image by Clikr-Free-Vector-Images at Pixabay

INTRODUCTION

Consumer demand for ready-to-eat foods is increasing due to the need for timesaving in the modern lifestyle, also they want healthy and nutritional foods (Pasqualone *et al.*, 2020; Arise *et al.*, 2021). One alternative to this demand is “snack foods” which provide the sense that the appetite is satisfied. It is a small portion of food consumed between meals and snacking could be a habit of young and old people because it supplies the calories needed during an active day, or it is just eaten for pleasure (Alamu *et al.*, 2020; Hess *et al.*, 2016). Some examples of snacks are cookies, cakes, sugar-sweetened beverages, and chips. Recent studies also indicate that legume flour can be incorporated into snacks instead of cereals, significantly improving their functional properties and their nutritional value (Szymandera-Buszka *et al.*, 2021). Legumes are highly beneficial in the diet of people, due they have considerable quantities of water-soluble vitamins, minerals, and bioactive ingredients such as polyphenols, essential amino acids, fibers, and proteins. Also, they are lower in levels of saturated fat, glycemic index (GI) (ranging from 16 to 30), salt, and sugar (Neder-Suárez *et al.*, 2021; Pasqualone *et al.*, 2020; Szymandera-Buszka *et al.*, 2021; Tas & Shah, 2021). Also, it is a cheaper source of protein and energy, particularly for rural populations (Arise *et al.*, 2021). The term legumes originated from the Latin word “*Legere*”, which refers to those plant species whose fruits are enclosed in pods and belong to the *Fabaceae* or *Leguminosae* family. The main legumes consumed by humans such as alfalfa, pea, bean, chickpea, beans, green beans, lentils, peanuts (groundnuts), and soybeans. Pulses are the edible seeds of plants in the legume family, all pulses can be called legumes, but not all legumes are pulses (Tas & Shah, 2021).

The bean (*Phaseolus* spp.) is a pulse that has spread practically throughout the world and is considered part of the basic diet of a large part of the population. In the western region of Mexico occurred the domestication of the common bean (*Phaseolus vulgaris* L.), so it is the second most-consumed legume, according to the INEGI in 2019. The annual bean production was 828, 113.9 tons, and currently, 70 species of the 150 existing worldwide have been reported in Mexico and five of them have been domesticated (*P. vulgaris* L., *P. coccineus* A. Gray, *P. lunatus* L., *P. acutifolius* A. Gray, and *P. dumosus* Mac Fady) (Lépiz, 2007). Regarding its nutritional content, the protein content varies from 14 to 33%, being rich in amino acids such as lysine (6.4 to 7.6 g/100 g of protein) and phenylalanine+tyrosine (5.3 to 8.2 g/100 g of protein), but with deficiencies in methionine and cysteine, despite this, the quality of cooked bean protein can become up to 70% compared to a protein of animal origin. Also, it has high concentrations of vitamins such as thiamine, riboflavin, and niacin and minerals such as phosphorus, iron, and zinc (Espinoza-García *et al.*, 2016; Ulloa *et al.*, 2011; Figueroa *et al.*, 2015). On the other hand, peanuts (*Arachis hypogaea* Linn), known as groundnut, are botanically defined as legumes and it is the main legume consumed worldwide, having great economic importance in countries such as China, India, and the USA (Wang *et al.*, 2021). Peanuts are rich in unsaturated fatty acids, phytosterols, and other bioactive such as fibers, tocopherols, all the essential amino acids, and phenolic antioxidants compounds. Also, it is an important source of high-quality protein (22-30%), carbohydrates (15-21%), fats (42-49%), vitamins B and E, minerals such as iron, zinc, potassium, and magnesium, antioxidant minerals (selenium, manganese, and copper),

and fiber content (8.5% approximately) (Arya *et al.*, 2016; Bravo *et al.*, 2018; Guo *et al.*, 2020). According to the Protein Digestibility Corrected Amino Acid Score (PDCAAS), peanut proteins are nutritionally equivalent to meat and eggs, also it is the biggest source of arginine (FAO, 2002). According to INEGI, fried snacks generate Mexico a market of 62,758 million pesos, which corresponds to a production of 22,558 tons, and at the end of 2014, the country consumed on average 157,000 tons of chips per year. So, chips-type snacks are the most consumed by young university students. For all of these, the objective of this study is to evaluate the sensory perspectives of chips-type snacks made from bean dry (*Phaseolus vulgaris* L) and peanut (*Arachis hypogaea* Linn) flours in a university population in the Toluca Valley.

MATERIALS AND METHODS

Raw material

Peanut (*Arachis hypogaea* Linn) and Black bean (*Phaseolus vulgaris* L) were acquired in the local market “Garis”, Mexico. The bean was washed and cooked with water and salt for 40 min in a pressure cooker, then dried in an oven (Hamilton beach, Virginia, EE. UU.) at 180 °C for 4 h. Finally, they were toasted at 100 °C for 15 min. The peanut was purchased previously toasted. Both were stored at room temperature until use.

Preparation of chips-type snacks

Peanut and black bean toasted were individually milled in a blender (Oster, Mexico) and sieved using a 0.4 mm mesh to obtain uniform particles. The peanut formulation (PF) contained 50% peanut flour, 12.5% rice flour, and 12.5% cornstarch. The black bean formulation (BbF) contained 50% black bean flour, 12.5% wheat flour, and 12.5% cornstarch. All mixtures were added with 1.5% salt and water was added until a malleable paste was obtained. PF and BbF flours were blended to form a thick paste, which was then extruded and fried using a deep fryer with the temperature held at 200 °C for 5 min.

Statistical design

The State of Mexico was taken as a model from the observation of the eating habits of university students to provide a product with sensory characteristics that meet the standards of quality and accessibility. A statistical-descriptive study was carried out through an analytical survey of the university population of the State of Mexico, located in the central zone of the Mexican Republic, at an altitude of 2683 m above sea level, made up of a total of 125 municipalities, has a territorial extension of 22,499.95 km² and a total of 16,992,418 inhabitants (INEGI, 2021), this being the state with the largest number of inhabitants in the republic. Surveying mainly autonomous universities (UAM, UAEMEX, etc.), technological institutes (UTVT, Technological Institute of Toluca, Tecnológico de Jicotitlan, etc.), and private (UNITEC, UVM, Universidad Milenium, etc.).

Description of the study

The obtaining of information was carried out through an analytical survey established by multiple-choice with the help of google forms, applied from September 6 to September

11, 2021, with an average duration of 3.5 minutes, to 137 people randomly university students of the State of Mexico with an age range of 17 to 28 years. Selecting topics related to the consumption of legumes to know the perspective of the consumer, his preference for them, and the habituality of their consumption, thus finally focusing on peanut and bean flours (Physical Environment Mexico, 2021).

Questionnaire and measurement scale

The questionnaire was divided into five sections: The first section seeks to clarify the definition of snack, as well as to know the percentage of consumption and preferences of the object of study on it. The second section is aimed at the knowledge of the participants about legumes, mainly in their importance in the diet, the frequency of their consumption, and the health benefits, including the nutrients they provide us. The third section focused on legume snacks, respondents were asked to provide information on: if they knew of any snack made from any legume flour if they had already consumed it if they were interested, and what type of legume flour snacks they would like to consume and in what form. In the fourth section he focused on the idea of the legumes selected in particular from flour, they were asked if they would be struck by any presentation of a snack based on bean and peanut flour in the market and if they considered that this snack was a good option to include it in their diet. In the fifth section, an approach was considered aimed at the packaging, portion, and cost of the product, to know the preferences and the value that the product could come to quote in the market and thus properly define the tastes of future consumers.

Method for sensory evaluation

Affective test

The evaluation was realized at the State of Mexico Universities. Sixty-eight consumers (age 18-33) assessed the snacks. They evaluated the acceptance in the categories of odor, taste, hardness, easy to break, and overall liking using a structured hedonic scale of 7 points (1 = dislike a lot, 7 = like a lot). Each sample was presented monadically to the consumers in a balanced complete block design.

Statistical analysis

A comparative analysis of the information obtained in the surveys was carried out, considering the sociodemographic variables of the female and male gender. The processing began with the organization of the database in Microsoft Excel. Subsequently, the values of each of the answers were calculated, and finally, the statistical software SPSS was used to identify the significant differences between the responses of the respondents ($p < 0.05$), applying the non-parametric Chi-square test. The t-Student test was conducted on an affective test by XLSTAT software version 2014.5.03 (Addinsoft, Paris, France) using an alpha limit value of 0.05 for affective test.

RESULTS AND DISCUSSION

Many snacks are classified as junk food due to their low nutrient content, high preservative content, and high sodium, sugar, and/or fat (Hess *et al.*, 2016; Neder-Suárez

et al., 2021). Currently, most snacks available are manufactured from cereals tending to be high in fat content, rapidly digestible starch, salt, and sugars, which could be contributing to the increased prevalence of obesity and diabetes (Tas & Shah, 2021). For all the above reasons it is important to know the food habits of university students, to offer new food developments that contribute to nutrition and can be incorporated into the diet as snacks. Figure 1 shows the differences in snack consumption in the gender populations. The participants were 30% male and 70% female. In this case, the female gender presented twice as many consumption preferences compared to the male population, these being significantly different ($p < 0.05$), unlike meat which does not present a difference in consumer preference between the genders. In addition, it can be observed that the female gender presents a 37% higher consumption of potato chips in comparison with the male gender, which together with the high consumption of nuts can be an indicator of the segment of the university population in which the consumption of chips-type snacks made from black bean and peanuts could be implemented.

In Germany, men judged the quantity of recommended fruit and vegetable servings to be substantially lower than women in a study of older UK individuals, aged 55-64 years (3.4 *vs.* 4.5 portions, respectively). Similarly, only 28% of guys properly knew that eating five or more servings per day is suggested, but 63% of ladies were aware of this guideline. Furthermore, just 28% of men, compared to 35% of women, were aware of the link between disease and fruit and vegetable consumption. In contrast with this study, Nutrition Report 2000 in Germany, the average meat consumption of men was 10-20 grams per day more than that of women, depending on age group (Westenhoefer, 2005).

Figure 2 shows the place where the products are purchased. Women have more preference than men to buy snacks in supermarkets and self-service stores, in markets, and prepared at home ($p < 0.05$). Schlinkert *et al.*, 2020 reported that young people in the Netherlands went to snack outlets, as a result, levels of obesity and overweight increased. However, they are snacking at home (58%), at work, or at school (23%). They ate at home

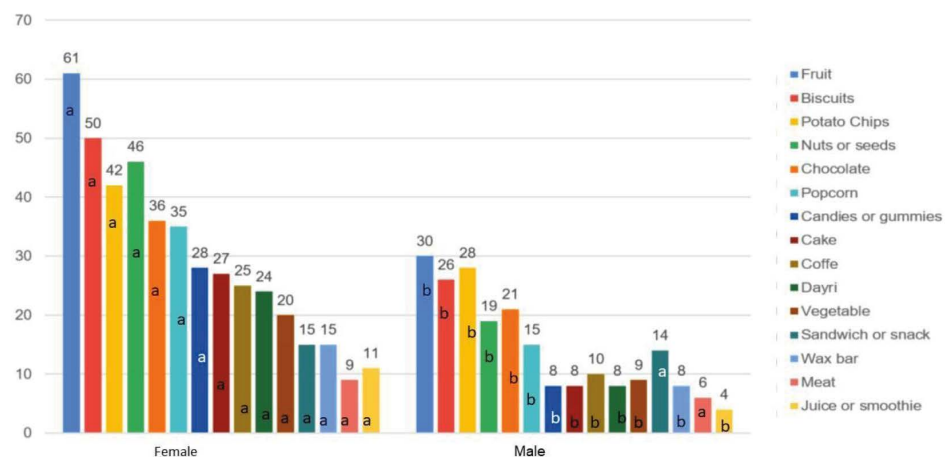


Figure 1. Frequency (%) of consumption of snacks in a population of university students in the State of Mexico. ^{a-b} Different letters between the same variable value indicate a significant difference between genders ($p < 0.05$).

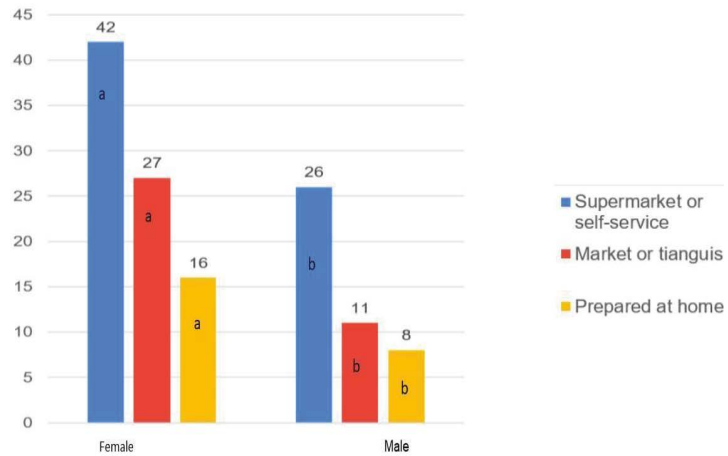


Figure 2. Frequency (%) of the place where snacks are obtained in a population of university students in the State of Mexico.

^{a-b} Different letters between the same variable value indicate a significant difference between genders ($p < 0.05$).

because of the price of snacks, and they prefer to buy them at local supermarkets than “on the go”.

Likewise, snacks are listed as impulse products, which are frequently described as low cost, and require the consumers to use minimal cognitive effort. Because it includes automatic and habitual subconscious decisions, it was discovered that the inclination to buy on impulse is significantly linked to the habit of eating snack foods (Duarte *et al.*, 2013).

Figure 3 shows the types of flour that the population prefers in the preparation of snacks. Peanut and chickpea flour are the most preferred by the female population ($p < 0.05$) unlike the male population. Subsequently, the uses of the other flours such as broad beans and lentils are lower consumption between both genders ($p > 0.05$).

Figure 4 shows the types of snacks consumed. Crispy chips and churros were highly preferred by the population, with women consuming more ($p < 0.05$). Subsequently, snacks

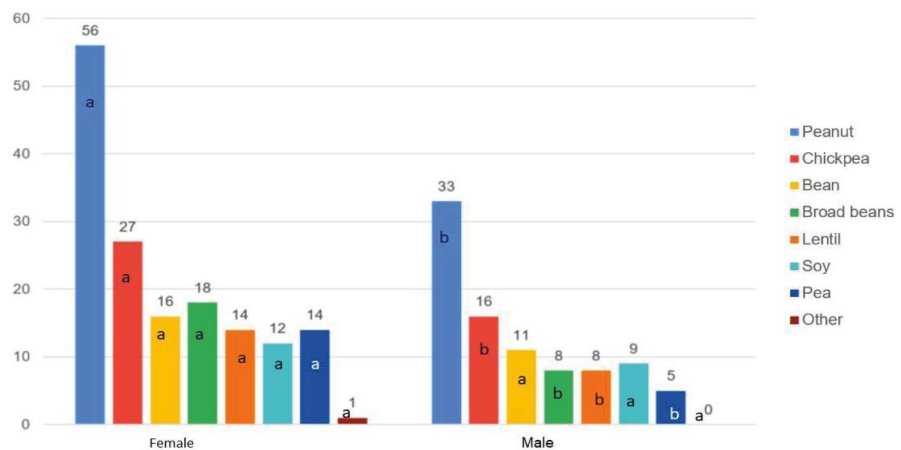


Figure 3. Frequency (%) of the type of flour preferred in snacks in a population of university students in the State of Mexico.

^{a-b} Different letters between the same variable value indicate a significant difference between genders ($p < 0.05$).

made from wheat flour and others had lower consumption but were similar between genders ($p > 0.05$). Duarte *et al.*, 2013 reported that because several studies have found a link between snack food consumption and the overweight and obesity problems of young people, public health policies and campaigns will be aimed at the development of healthy snacks.

Figure 5 shows the preference of the place in the consumption of snacks. Women prefer to consume these products more frequently in their homes compared to men ($p < 0.05$). While, in other places such as the university, work, street, and other places, consumption was lower in both genders and without significant differences ($p > 0.05$).

Figure 6 shows the nutritional characteristics of the snacks. Women prefer products with higher content of vitamins, minerals, and fiber than men ($p < 0.05$). In the case of protein, calories, fat, and sodium contents, there were no significant differences between genders ($p > 0.05$).

Similarly, Westenhofer (2005) reported that gender-dependent differences in food choice, women generally show a healthier pattern of food choice. For example, the

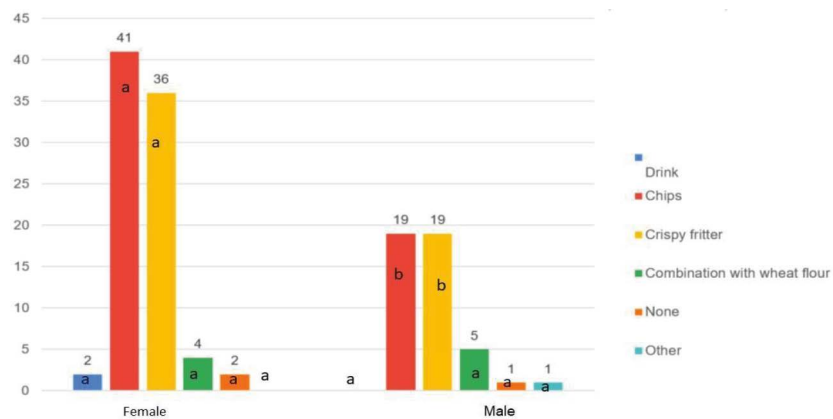


Figure 4. Frequency (%) of the type of consumption of snacks in a population of university students in the State of Mexico.

^{a-b} Different letters between the same variable value indicate a significant difference between genders ($p < 0.05$).

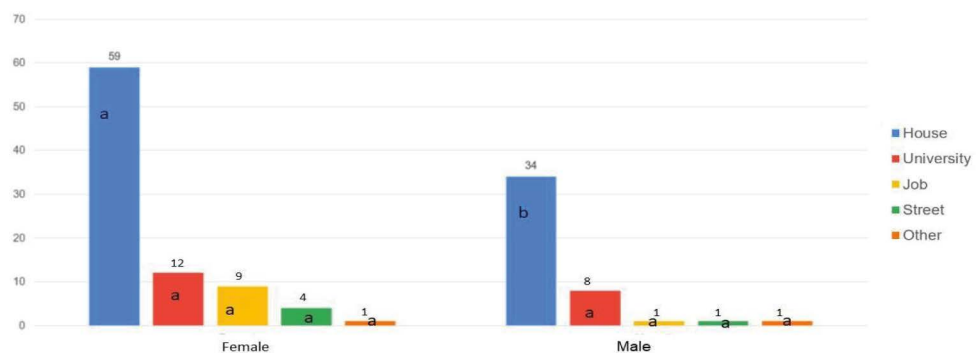


Figure 5. Frequency (%) of the preference of the place for the consumption of snacks in a population of university students in the State of Mexico.

^{a-b} Different letters between the same variable value indicate a significant difference between genders ($p < 0.05$).

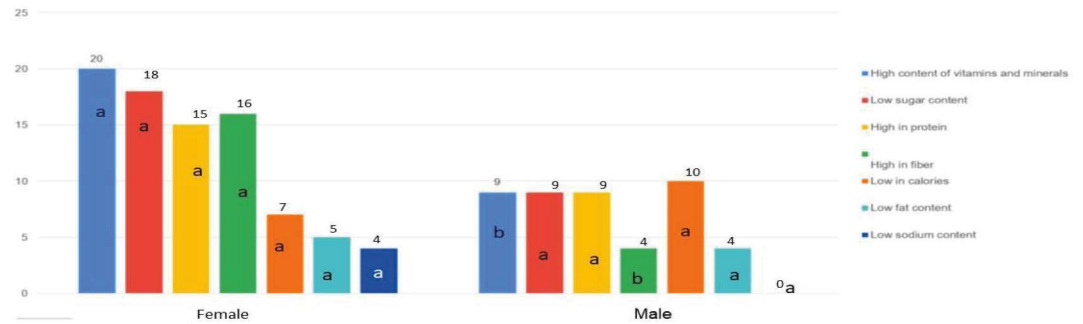


Figure 6. Frequency (%) of the preference of the nutritional characteristics of snacks preferred by the population of university students in the State of Mexico.

^{a-b} Different letters between the same value of the variable indicate a significant difference between genders ($p < 0.05$)

International Health and Behavior Survey (IHBS) applied a self-report, questionnaire-based study that looked at a variety of health behaviors in a total of 19,298 university students from 23 different nations. Women avoid high-fat foods, consume high-fiber foods, eat fruit every day, and never add salt to their meals compared to men. Likewise, consumers purchasing snack foods evaluated health/nutrition as the second most important attribute after taste/flavor in New Zealand (Kahiya *et al.*, 2013). In the end, because gender has an inextricable link with purchasing decisions, it must be analyzed separately for each product and company (Zoi, 2017).

Affective test

There was no significant difference ($p > 0.05$) between the samples prepared with beans and peanuts for all categories. The rating of the two samples was “Like” in all categories (Figure 7).

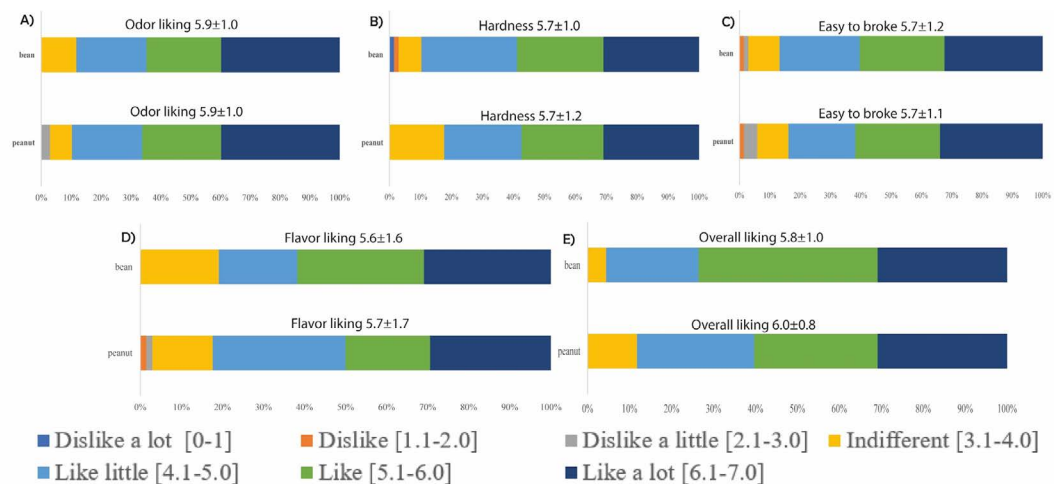


Figure 7. Frequency of acceptance of odor (A), hardness (B), easy to break (C), flavor (D), and overall liking (E) (media ± std). No significant difference ($p > 0.05$) between bean and peanut snacks.

CONCLUSION

The consumption of legumes is an important basis for a healthy diet. To know the sensory perspectives of university students could provide important information to develop healthier and easier-to-eat snacks. The chips-type snacks made with PF and BbF could be a healthy alternative for the younger consumers, also it kinds of products have good acceptability between them. However more studies about the characterization of the snack are required, also a mix of both legumes could be realized to obtain an add value product.

REFERENCES

- Alamu, E. O., Maziya-Dixon, B., Olaniyan, B., Ntawuruhunga, P., & Chikoye, D. (2020). Evaluation of nutritional properties of cassava-legumes snacks for domestic consumption: consumer acceptance and willingness to pay in Zambia. *AIMS Agriculture and Food*, 2020, 5(3), 500-520.
- Arise, A. K., Malomo, S. A., Owolabi, O., & Arise, R. O. (2021). Proximate, Antioxidant, and Sensory Properties of Tidbit Snacks from Cassava Enriched with Processed Benniseds. *ACS Food Science & Technology*, 1(2), 268-274.
- Arya, S. S., Salve, A. R., & Chauhan, S. (2016). Peanuts as functional food: a review. *Journal of food science and technology*, 53(1), 31-41.
- Bravo A., Navarro E., Rincón C. & Soriano M. (2018). Características fisicoquímicas y perfil de ácidos grasos de dos cultivares de cacahuete de la Mixteca Poblana. *Revista de Ciencias Naturales y Agropecuarias*, 5(15), 9-18
- Duarte, P., Raposo, M., & Ferraz, M. (2013). Drivers of snack foods impulse buying behavior among young consumers. *British Food Journal*, 115, 1233-1254.
- Espinoza-García, N., Martínez-Martínez, R., Chávez-Servia, J. L., Vera-Guzmán, A. M., Carrillo-Rodríguez, J. C., Heredia-García, E., & Velasco-Velasco, V. A. (2016). Contenido de minerales en semilla de poblaciones nativas de frijol común (*Phaseolus vulgaris* L.). *Revista fitotecnia mexicana*, 39(3), 215-223.
- FAO (Food and Agriculture Organization of the United Nations). 1994. Definition and classification of commodities, 4. Pulses and derived products. Available at: <http://www.fao.org/es/faodef/ fdef04e.htm>. Consultado en febrero 2022.
- FAO/WHO/UNU (2002) Protein and Amino Acid Requirements in Human Nutrition. *In: Report of a Joint FAO/WHO/UNU Expert Consultation, World Health Org Tech Report No.935.*
- Figuroa J., Guzmán S. & Herrera M. (2015). Atributo nutricional y nutracéutica de panqué y barritas a base harina de frijol (*Phaseolus vulgaris* L.) *Biotechnia*, 17(3), 9-14.
- Food and Agriculture Organization (FAO). 2015 International year of pulses, Viale delle Terme di Caracalla 00153, Rome Italy. Consultado 15 de febrero 2022. <https://www.fao.org/pulses-2016/news/news-detail/en/c/337107/>
- Guo, C., Xie, Y. J., Zhu, M. T., Xiong, Q., Chen, Y., Yu, Q., & Xie, J. H. (2020). Influence of different cooking methods on the nutritional and potentially harmful components of peanuts. *Food chemistry*, 316, 126269.
- Hess, J. M., Jonnalagadda, S. S., & Slavin, J. L. (2016). What is a snack, why do we snack, and how can we choose better snacks? A review of the definitions of snacking, motivations to snack, contributions to dietary intake, and recommendations for improvement. *Advances in Nutrition*, 7(3), 466-475.
- INEGI (Instituto Nacional de Estadística y Geografía) https://www.inegi.org.mx/temas/agricultura/#Informacion_general. Consultado febrero de 2022.
- Kahiya, E., Forbes, S., & Balderstone, C. (2013). An Exploratory Analysis of Snack Food Purchasing Behavior in New Zealand. *In: Looking Forward, Looking Back: Drawing on the Past to Shape the Future of Marketing*, Springer, Cham, 57-65.
- Lépiz I., R. 2007. Avances de investigación 2003-2006. Red Frijol. Sistema Nacional de Recursos Fitogenéticos para la Alimentación y la Agricultura. Servicio Nacional de Inspección y Certificación de Semillas (SNICS). Las Agujas, Municipio de Zapopan, Jalisco, México. 97 p. Alimentación y la Agricultura (SINAREFI). Universidad de Guadalajara. México.
- Neder-Suárez, D., Quintero-Ramos, A., Meléndez-Pizarro, C. O., de Jesús Zazueta-Morales, J., Paraguay-Delgado, F., & Ruiz-Gutiérrez, M. G. (2021). Evaluation of the physicochemical properties of third-generation snacks made from blue corn, black beans, and sweet chard produced by extrusion. *LWT*, 146, 111414.

- Pasqualone, A., Costantini, M., Coldea, T. E., & Summo, C. (2020). Use of legumes in extrusion cooking: A review. *Foods*, 9(7), 958.
- Schlinkert, Caroline & Gillebaart, Marleen & Benjamins, Jeroen & Poelman, Maartje & Ridder, Denise. (2020). Snacking and The City: Unexpected Low Sales of an Easy-Access, Tasty, and Healthy Snack at an Urban Snacking Hotspot. *International Journal of Environmental Research and Public Health*, 7, 7538.
- Szymandera-Buszka, K., Gumienna, M., Jędrusek-Golińska, A., Waszkowiak, K., Heś, M., Szwengiel, A., & Gramza-Michałowska, A. (2021). Innovative Application of Phytochemicals from Fermented Legumes and Spices/Herbs Added in Extruded Snacks. *Nutrients*, 13(12), 4538.
- Tas, A. A., & Shah, A. U. (2021). The replacement of cereals by legumes in extruded snack foods: Science, technology and challenges. *Trends in Food Science & Technology*, 116, 701-711.
- Ulloa, J. A., Rosas Ulloa, P., Ramírez Ramírez, J. C., & Ulloa Rangel, B. E. (2011). El frijol (*Phaseolus vulgaris*): su importancia nutricional y como fuente de fitoquímicos. *Revista Fuente CONACYT* 3(8). <http://fuente.uan.edu.mx/publicaciones/03-08/1.pdf>. Consultado febrero 2022.
- Wang, D., Sun, L., Liu, X., Niu, Z., Chen, S., Tang, L., & Lin, X. (2021). Replacing white rice bars with peanuts as snacks in the habitual diet improves metabolic syndrome risk among Chinese adults: a randomized controlled trial. *The American Journal of Clinical Nutrition*, 113(1), 28-35.
- Westenhofer J. (2005). Age and gender dependent profile of food choice. *Forum of nutrition*, 57, 44-51.

