

Appearance, Tastiness, and Healthiness Perception of University Students Towards Sustainable Cereal Snack Bar Enriched With Pumpkin

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Submitted : 19 Nov 2024; Published : 4 Dec 2024

Citation: Abreu, B. et al. (2024). Appearance, Tastiness, and Healthiness Perception of University Students Towards Sustainable Cereal Snack Bar Enriched With Pumpkin. *J N food sci tech*, 5(4):1-7. DOI : <https://doi.org/10.47485/2834-7854.1045>

Abstract

Pumpkin (*Cucurbita maxima*) is an endogenous product of low commercial value. Cereal bars are used as a snack, mainly in intermediate meals. The development of new food products with low commercial value contributes to endogenous products' valorisation and sustainability. This study aimed to develop a cereal bar using pumpkin and pumpkin seed flour and analyse appearance, tastiness, and healthiness perception related to it by university students from different areas. The nutrition students' group was constituted of 33 students and the hospitality group was constituted of 26 students, both rated the bar in terms of appearance, tastiness and healthiness perception using a Likert scale from 1 (lower value) to 5 (higher value). Based on the global appearance was notorious the higher value rate of the nutrition students (32.2%) compared to the hospitality students (3.4%). The developed cereal-pumpkin bar seems to be an interesting alternative to other snack bars available on the market.

Keywords: Pumpkin derivate; Endogenous product; Sustainable food; Appearance; Tastiness; Healthiness.

Introduction

Food system outcomes go back around 20 years for the interest in more systematic approaches, in reaction to the displeasure with food supply development demands established on the unique linear food security thinking (Brouwer et al., 2020). A clear key advantage of the recent methodology for food system transformation is the clear distinction made between causes and results. These include contemplating the interactions, opposing concerns and calculated action topics to funding food system innovations at different dimensions such as policy and practice. Food systems must achieve to provide original and pioneering practices to solve public concerns in various fields (such as nutrition related problems, climate change escalation and for all inclusiveness). So, hands-on actions should be focused across the compromise and engagement of multiple national companies and local stakeholders (Vries, 2021; Sirieix et al., 2013).

Food system approaches that consider the relation between several points like different food behaviors, the global food market and the nutritional, environmental, social and economic sequels, have become widespread in discussions on policy elaboration. Frameworks of food systems are regularly mentioned in governmental dialogue to debate for specific attitudes and restructurings to decrease malnutrition or to support for sustainable food system effects (Brouwer et al., 2020). The discussion on how food systems can be better situated to offer safeness and healthful diets and contribute to human health is important to promote ecological sustainability and resilience to climate change. Scientific research is missing on how to convert food systems so that they benefit human health whilst also shielding ecological assets, accompanying sources of incomes and affordable consumption of food. And at the same time safeguarding social, cultural and ethical values (Fanzo et al., 2021).

Reaching food security regarding the rushing food supply demand, competition for draining supplies and the environment deteriorating facility to buffer snowballing anthropogenic impacts is currently understood as the new dare of the world (Vermeulen et al., 2012). A safe functional area for food systems permit to evaluate of which type of diets consumption and food production practices is defined as worldwide aim to support guaranteeing that the United Nations Sustainable Development Goals (SDG) and Paris Agreement are achieved (Eat-Lancet Commission (ELC), 2019) (Eat-Lancet Commission (ELC), 2019; United Nations Environment Programme (UNEP), 2016). Europe has newly assumed the SDG and is devoted to be the precursor for executing them by 2030 (European Commission (EC), 2016). The use of products with low commercial value and valorization is also considered by the Food and Agriculture Organization one of the new trends in food and agriculture for 2050 (Food and Agriculture Organization (FAO), 2017).

Food consumption is a crucial and inevitable part of routine, plus it is an extent where individual consumption is meticulously linked to environmental sustainability. The association of consumers and their understanding of ecological harms and the capacity to do applicable connections among the products consumed and ecologic subjects is called environment literacy. This is critical data that issues into green consumption and consequently achieves sustainable development strategies (Su et al., 2019). With the population growth the global food production has been following the demand, however close to 820 million people have insufficient amount of food. In addition, others consume low-quality diets marked by micronutrient deficiencies contributing to a considerable increase in the incidence of obesity and non-communicable diseases, such as coronary heart disease, stroke and diabetes (Willett et al., 2019). It is vital to contemplate how the wider food system affects the diets, nutrition and health consequences of populations (Fanzo et al., 2021).

Agricultural systems transformation and similar the food systems transformation to which this contributes, has been the subject of debate for several previously decades (Klerkx & Begemann, 2020). Therefore, is evident that techniques on how food is produced, distributed and consumed affect sustainability. This forces a reasonable modification of the mentality concerning the entire food system, predominantly to develop fundamental awareness associated to it. Plus, to recognize breaks to project meaningful activities to encourage the evolution (Peano et al., 2019). Local food is an emerging consumer trend, as well as food producers, distributors, policymakers and researchers in many industrialized countries. (Hiroki et al., 2016).

In recent years, pumpkins have attracted considerable consideration because of the several inherent biological characteristics such as the high content of polysaccharides, phenolic acids, vitamins, dietary fiber, and microelements (Ji et al., 2021). Furthermore, pumpkin seeds are excellent source of magnesium, potassium, phosphorus, aside from others

minerals for example zinc, manganese, iron, calcium, sodium, and copper (Dotto & Chacha, 2020). Though pumpkin seeds are mainly considered as agro-industrial waste, they work as powerhouses of nutrients through remarkable nutraceutical properties and functional components (Ji et al., 2021). Pumpkin is an endogenous product of low commercial value and cereal bars are used as a snack, mainly in intermediate meals (Dotto & Chacha, 2020; Yan et al., 2017).

There is aware that regular ingesting of fruit and vegetables should be a part of a healthy food regime. Considering obstacles of increasing vegetables consumption one of them is the time required to prepare and cook them. Therefore, it is not astonishing when it comes to pumpkins, consumers prefer products available most of the time of the year, proper for several uses, with extended shelf-life and without dirt (Orrego et al., 2014). Snack foods provide above than 20% of the daily energy intake in mostly of the Western countries. Correspondingly, food industry has been calling for high nutrition value products but the motivation has been on export and sales instead of enhancement public health (Yan et al., 2017). The aim of this paper is to develop a cereal bar using pumpkin and pumpkin seed flour, carry out its nutritional assessment and sensory analysis in nutrition and hospitality students.

Materials and Methods

Snack cereal bar development

A cereal bar based on the following ingredients: dehydrated pumpkin, oats, honey, almonds, puffed rice, water, walnuts, dehydrated cranberries, pumpkin seed flour, brown sugar and vanilla essence was developed. Then, it was significant to determine the appearance, tastiness and healthiness perception of possible future consumers.

Snack cereal bar analysis

Nutritional assessment of the cereal bar was carried out using the raw material labels and the Portuguese Food Composition Table (INSA, 2021), considering the quantity of the ingredients and the nutritional values for 100g of product. The final product was appreciated and evaluated by a group of nutrition and hospitality students. The nutrition students' group was constituted by 33 students and the hospitality group was constituted by 26 students. Both groups' subjects rated the bar in terms of their opinion of composition, such as general appearance, color, flavor, texture, smell, natural and healthiness using a Likert scale from 1 (lower value) to 5 (higher value). In order to be possible to compare the data between the groups, the results were translated from absolute values to relative (percentage) values.

Ethics Statement

The study protocol was approved by the Polytechnic Institute of Coimbra Ethic Committee, N° 160_CEIPC/2022 was obtained. The present study followed the recommendations from the Declaration of Helsinki. Previously, participants were knowledgeable concerning the description, purpose, hazards of the study and afterward provided informed consent.

Results

Nutritional Analyses

The list of ingredients by percentage of the cereal bar is presented to ensure the high nutritional density value of the snack bar (Table 1). In order to translate the list of ingredients for nutritional analyses is presented too important values such as energy, protein, carbohydrates, sugars and fat. As a recommendation for possible future consumers, a portion of 25g was inserted in the nutritional analyses next to the standard 100g of the cereal bar composition (Table 2).

Percentage	Ingredients
16%	Oat
14%	Almond cubes
9%	Puffed rice
6%	Pumpkin flour
5%	Butter without salt
23%	Honey
5%	Brown sugar
<1%	Vanilla essence
7%	Dehydrated pumpkin
7%	Nuts
7%	Dried blueberries

Table 1: Percentage list of ingredients of cereal bar.

	100g	Portion (25g)
Energetic value (kcal)	435	108,8
Protein (g)	18,5	4,6
Carbohydrates (g)	36,1	9,0
Sugars (g)	15,5	3,9
Fat (g)	22,6	5,7

Table 2: Nutritional analyses (per 100g and per 25g) of cereal bar.

Appearance

The appearance perception was determinate by two important factors evaluated, such as the general appearance and color (Figure 1). In general, hospitality students are more demanding in terms of appearance issues than nutrition students.

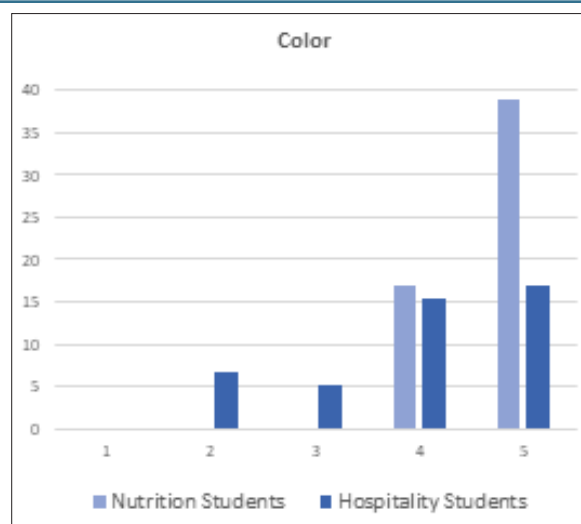
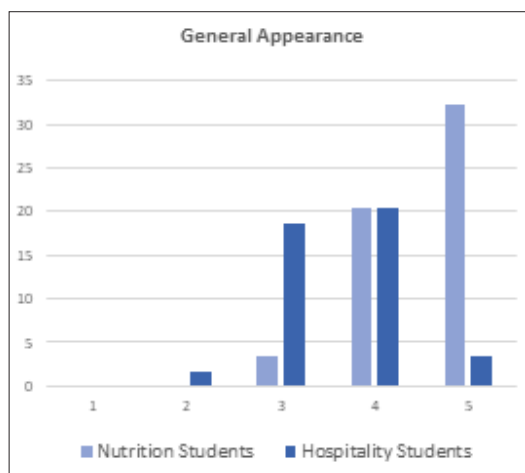
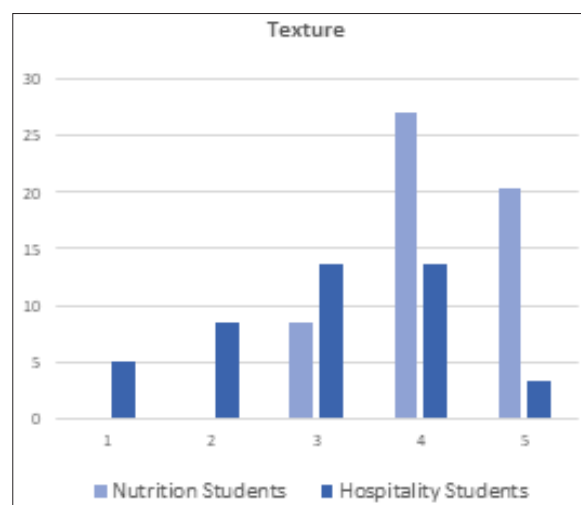
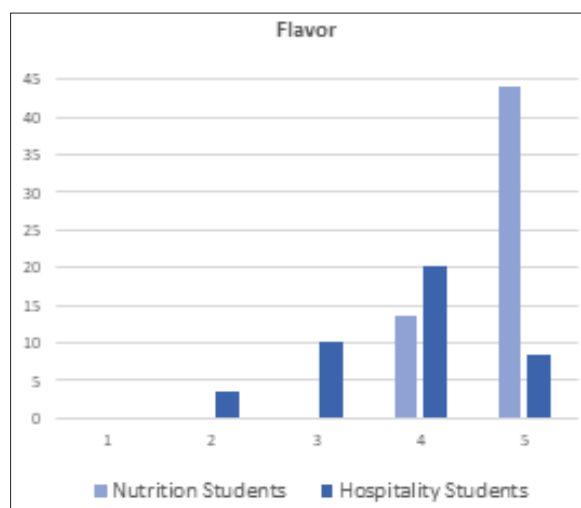


Figure 1: Global appearance (general appearance and color perceptions) of pumpkin snack bars.

Tastiness

For tastiness perception purposes, three bases were subjected to scrutiny as flavor, texture and smell (Figure 2). About tastiness, hospitality students are more demanding than nutrition students.



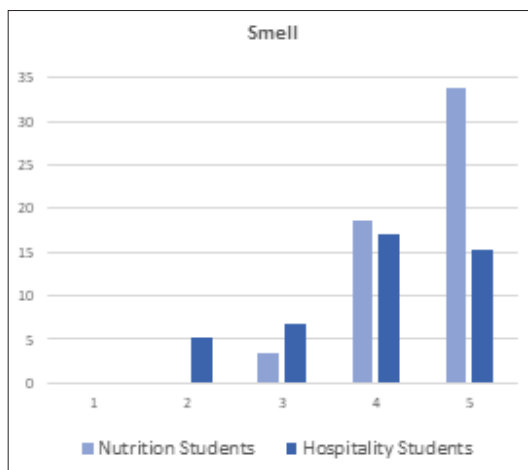


Figure 2: Tastiness (flavor, texture and smell perceptions) of pumpkin snack bars.

Healthiness

The healthiness perception was divided into two determinants of which natural and healthy (Figure 3). In general, hospitality students are more demanding in terms of healthiness issues than nutrition students.

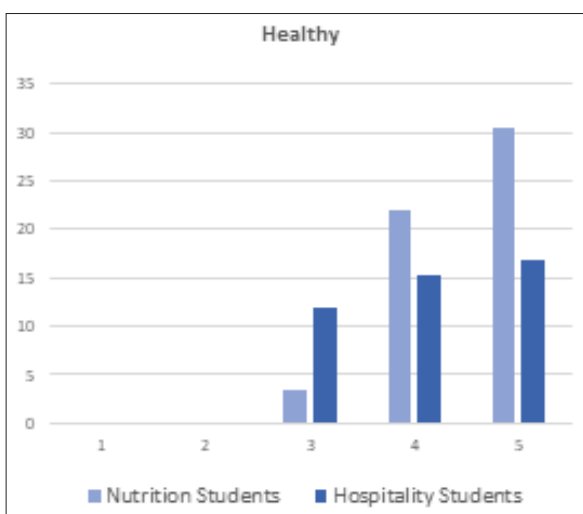
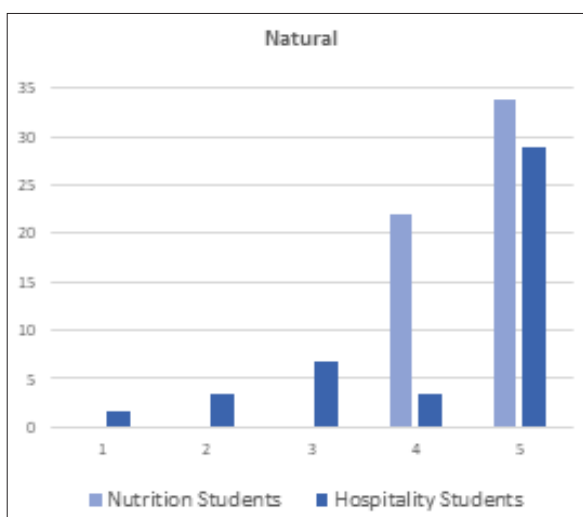


Figure 3: Healthiness (natural and healthy perceptions) of pumpkin snack bars.

Discussion

Examples of extensive food description systems have been increasing, which classifies all types of food items (from simple ingredients to complex food products) using a hierarchy of different levels (Eftimov et al., 2020; Davidou et al., 2020). Starting with extrinsic cues that affect the properties of a product, such as its appearance, shape, and color cannot be changed without altering the physical products (Cao & Miao, 2021). Therefore, the food's visual appearance takes the former impress and leads customers to lure insinuations about product quality that impacts the acceptance (Bandy et al., 2021). However, it is common for snacks to be covered by a product packaging, and indeed packaging acts as an advantage empirical to improve consumers' palate sensitivity perception (Cao & Miao, 2021). If the product will be placed on the market, it will be important to have similar experience with the food packaging itself.

Taste combines determinants such as smell and tactile sensations to form flavors, that allows to recognize and distinguishing food items as familiar or new (Breslin, 2013). Meanwhile, tastiness is explained as an experienced quality that can be assessed after consumption (Haasova & Florack, 2019). A lot of studies argue for the essential role of tastiness and health in managing food select (Mergelsberg et al., 2019; Londerée & Wagner, 2021). Considering how the proportions in the brain are encrypted is analytically significant considerate the cognitive and neural mechanisms over every day eating (Londerée & Wagner, 2021). It is rational to say that unique numeric information did not simulate the taste experience to form an expectation about the tastiness, although can be used for a quick health judgment based on food comparison (Haasova & Florack, 2019). Thus, the gap between tastiness and healthiness is larger when related processing of food products (Mergelsberg et al., 2019).

A lot of categories influence the perceived healthiness of a product, for example, the effect of previously communicated message, the profile and coloring of the package, the ingredients used and taste of the product, such as other endless sensory features (Plasek et al., 2020). The higher the level of perceived healthiness of a product is, more is probable that the product will be acquired (Plasek et al., 2020; Provencher & Jacob, 2016). Relevant cognitive factors (as eating principles and foods self-categorizes), marketing approaches, and nutrition information affect perceived healthiness, and then have an influence on diet intake (Provencher & Jacob, 2016). An overall score assessment helps to provide a consumer perception of food environment healthiness according to the processing of the foods (Borges et al., 2021). Public health efforts to expand the healthiness food and must emphasis on decreasing calories, total fat, saturated fat, and sodium (Alexander et al., 2021). All that factors were taken into account in the development of the pumpkin cereal bar.

Universities are a promising setting for emerging, analysis, and encouraging approaches to modulate food environments, by educating students as future citizenries using the space

to prototypical and analyze innovative concepts (Mann et al., 2021). The data collected on the university campus by nutrition and hospitality students allowed to perceive exactly that point. It is common for students to experience an absence of time due to their workload, a nonexistence of healthy offers at the university refectory and excessive prices of healthful products as the principal obstacles to not follow a healthful improved food regime (Stroebele-Benschop et al., 2018; Sacks et al., 2019). The development of this pumpkin cereal bar is a substantial opportunity to improve the food offered at universities and hopefully worldwide. Such approaches can optimistically stimulate the dietary patterns of students and concurrently exhibit leadership in looking forward social to institutional modulation (Stroebele-Benschop et al., 2018).

In sum, there was a positive assessment for all parameters evaluated, which was higher among the nutrition students compared with the hospitality ones. So, it is important to consider the quantity of information a person might have concerning a particular food category (Londerée & Wagner, 2021). It is possible to use a wide variety of food stimuli across multiple food categories, to test for the robustness and generalizability perceptions of food products (Mulier et al., 2021). Certain food intake questionnaires are commonly used in current nutritional research, however not so frequently are food perception questionnaires (Ricci et al., 2019). Additional requirements should be understood about developmental changes in healthy food perceptions and preferences (Serrano-Gonzalez et al., 2021). The developed pumpkin and cereal bar seem to be an interesting alternative to other cereal bars available on the market, particularly among audiences with a greater interest in healthy eating.

Conclusions

This research contributes to food science field due to translate a culinary application that involve the development a new recipe, with nutritional and environmental concerns. Additionally, the study analyses the consumer perception related to appearance, tastiness, and healthiness, identifying possible new culinary trends related to these issues. The results point to the interest of both consumers to the product and a particular exigency related to hospitality students, that reveals the acceptability for future works involving research in this field.

Acknowledgments

The data was obtained at the School of Hospitality and Tourism of Coimbra, Coimbra, Portugal.

Author Contributions

BA, LG, JL: Conceptualization, Methodology; BA: Data curation, Writing - Original draft preparation; LG: Visualization, Investigation; BA, LG, JL: Supervision, Validation; JL: Writing - Reviewing and Editing.

Funding

None organization or foundation funded this research.

Competing Interests

The authors have declared that no competing interests exist.

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