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Abstract

The development of new foods is a constant challenge for scientific research. In this sense, mixed fruit and vegetable drinks are excellent carriers and means of delivery of nutrients, bioactive compounds, antioxidants, vitamins and minerals. That is why the purpose of this research was to development and evaluate a beverage prepared with Lupine (Lupinus Mutabilis Sweet), strawberry (Fragaria ananassa) and blackberries (Rubus species). Three different formulations were proposed, and subjected to sensory validation to evaluate the treatment with greater acceptance by applying a five-point hedonic scale and untrained panel of consumers who rated the attributes appearance, color, smell and taste. The treatment with greater acceptance was analyzed to determine their content of moisture, ash, protein, fibre, fat, carbohydrates and antioxidant activity. The results show significant differences ($p>0.05$) in the sensory evaluation of the treatments. The treatment formulated with 40% berries and 5% lupin was the one that had the highest score (acceptability 4.40). The drink contains (g/100ml) 80.50 moisture, ash 0.90, proteins 1.52, fats 0.92, fibre 0.27, carbohydrates 16.16 and energy 79 Kcal/100 ml. As expected, the antioxidant capacity of the drink was high, obtaining a value of 2245.8 µmol ET. In conclusion, due to its acceptability and nutritional value could be used as an alternative to solve nutritional problems and health that affect the population

Keywords: Lupine, vegetable drink; sensory analysis; antioxidant capacity; protein.

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Resumen

El desarrollo de nuevos alimentos resulta en un constante desafío para la investigación científica. En este sentido, las bebidas mixtas de frutas y vegetales son excelentes portadoras y medios de entrega de nutrientes, compuestos bioactivos, antioxidantes, vitaminas y minerales. Es por ello, que el propósito de esta investigación fue desarrollar y evaluar una bebida preparada con Lupino (Lupinus Mutabilis Sweet), fresa (Fragaria ananassa) and mora (Rubus species). Tres diferentes formulaciones fueron preparadas y sujetas a una evaluación sensorial para evaluar el tratamiento con mayor aceptación, aplicando una escala hedónica de cinco puntos a un panel no entrenado quienes puntualizaron t los atributos de apariencia, color, olor and taste. El tratamiento con mayor aceptación fue analizado para determinar su contenido de húmeda, cenizas, proteína, grasa, carbohidratos y actividad antioxidante. Los resultados muestran diferencias significativas ($p>0,05$) en la evaluación sensorial de los tratamientos. El tratamiento formulado con 40% frutos rojos y 5% de lupin fue el que tuvo la mayor puntuación (aceptabilidad 4,40). La bebida contiene (g/100ml) 80,50 de humedad, 0,90 de cenizas, 1,52 de proteína, 0,92 de grasa, 0,27 de fibra,16,16 de carbohidratos y 79 Kcal/100 ml. Como se esperaba la capacidad antioxidante de la bebida fue elevada, obteniendo un avalor de 2245.8 µmol ET. En conclusión, debido a su aceptabilidad y valor nutritivo podría ser utilizada como alternativa para resolver problemas nutricionales y de salud que afectan a la población.

Palabras clave: Lupin bebida vegetal, evaluación sensorial, capacidad antioxidante, proteína

Introduction

The demand for foods and beverages with therapeutic and functional features has increased as a result of rising consumer awareness of health and wellness. In natural, plants are abundant, widespread, and inexpensive, in addition to being rich in bioactive components that are beneficial to health. With the diversification of the food industry and commerce, plant-based beverages may become a promising new category of health functional foods in our daily lives (Tong et al., 2023).

Legumes have been a staple food included in the diet of a diversity of cultures around the world. Their high nutritional value and low-cost food made them an interesting source compounds such as bioactive components and phytochemicals (Sánchez-Villegas et al., 2018). These phytochemicals have anti-inflammatory, anticancer, anti-microbial, and anti-ulcerative effects. In addition, pulses are also rich in vitamins [folate, thiamine (B1), riboflavin (B2), and niacin (B3)] and minerals (potassium, calcium, magnesium, phosphorus, and iron). Due to their high protein, content and low cost, pulses are referred to as ‘poor people's meat (Venkidasamya, et al., 2019).

Pulses for human consumption cover crops as peas (Pisum sativum), beans (Phaseolus spp), Vicia faba), chickpea (Cicer arietinum), pigeon pea (Cajanus cajan), lentils (Lens esculenta, Ervum lens), and lupin (Lupinus spp.) among others legume seeds widely produced as soybeans (Glycine max) (FAO, 1994; Giusti, et al., 2017). Lupinus mutabilis is a native legume of the central region of the South American Andean region. For centuries, the indigenous population in Ecuador, Bolivia and Peru has used this ancient food crop commonly known as chocho. The consumption of this type of lupin is widely distributed due to its high nutritional value especially in terms of protein. In addition, lupin is high in fat, minerals and dietary fiber (Arnoldi & Greco, 2011).

The main use of Lupins is as common food, both for humans and for animals, although they have recently been found to be an excellent candidate for the development of functional foods. Lupins have highly desirable characteristics for cultivation due to their ability to fix nitrogen and to grow in infertile soils, and its value in crop season rotations with cereal grains, and oil seeds (Johnson et al., 2017).

On the other hand, some fruits contain many bioactive compounds, such as blackberries (Rubus species) and strawberry (Fragaria ananassa) which are a rich source of antioxidants and have a high content of phenols (flavonoids and phenolic acids), minerals, and monosaccharides (Loncarevic et al., 2018). Numerous research studies have shown that phenolic compounds originating in blackberry have beneficial effects on human health, reducing the risk of cardiovascular diseases, type 2 diabetes, cancer, and degenerative processes in the brain. The major polyphenolic compounds in berries are anthocyanins, hydrolyzable tannins (gallo- and ellagitannins), flavonols, and flavan-3-ols, including proanthocyanidins (Tavares et al., 2012).

Additionally, berries demonstrate a potential prebiotic effect, attributed to their polyphenolic compounds' ability to support gut health by promoting the proliferation of beneficial microorganisms (Diez-Sanchez, Quiles, & Hernando, 2023). Thus, the combination of these foods rich in protein, fiber, certain minerals, vitamins, and bioactive compounds makes the drink an important potentially functional food. Therefore, the objective of this study were develop and evaluate a beverage prepared with Lupine (Lupinus Mutabilis Sweet), strawberry (Fragaria ananassa) and blackberries (Rubus species).

State of the Art

The development of plant-based functional beverages has gained increasing attention in food science due to growing consumer interest in nutritional quality, sustainable food production, and the incorporation of bioactive compounds into everyday diets. Recent research has focused on identifying alternative plant ingredients capable of providing essential nutrients while maintaining desirable sensory characteristics. Tong et al. (2023) highlighted the potential of natural plant extracts in beverage formulations, emphasizing their nutritional functionality, processing requirements, and safety considerations. Similarly, Venkidasamy et al. (2019) examined the nutritional and functional properties of legumes, identifying their proteins, dietary fiber, and phytochemical constituents as valuable resources for the development of innovative food products. These contributions provide a scientific foundation for exploring beverages formulated with legumes and fruits as complementary ingredients.

Among the legumes investigated for food innovation, lupin has attracted particular interest because of its nutritional composition and potential applications in plant-based products.

Arnoldi and Greco (2011) described the nutritional and nutraceutical characteristics of lupin proteins, highlighting their relevance as alternative sources of dietary protein. Johnson et al. (2017) further examined the nutritional and health-promoting attributes of lupins, emphasizing their potential contribution to sustainable food systems and diversified diets. In the Andean region, Lupinus mutabilis Sweet represents a particularly relevant crop because of its traditional consumption and agricultural importance. Its incorporation into processed foods offers opportunities to diversify the use of regional agricultural resources and develop products with added nutritional value.

Previous investigations have demonstrated the feasibility of incorporating lupin into beverage formulations. Cerezal et al. (2012) developed a protein-rich beverage using carob, lupin, and quinoa intended for preschool diets, providing an important precedent for the use of this legume in liquid food products. Their research supports the technological potential of combining lupin with other plant ingredients to obtain nutritionally differentiated beverages. More recently, Oliveira et al. (2022) investigated hydrolyzed proteins obtained from Lupinus albus for applications in the functional food industry, illustrating opportunities for adding value to lupin-derived ingredients. Although these studies involved different lupin species and processing approaches, they collectively demonstrate the versatility of lupin in food product development.

Nevertheless, the incorporation of legumes into beverages presents technological and sensory challenges that must be addressed to achieve consumer acceptance. Laaksonen et al. (2021) investigated the effects of lactic acid fermentation on the sensory and chemical quality of dairy alternatives prepared from lupin seeds, demonstrating the importance of processing conditions in determining product characteristics. Likewise, Firew et al. (2022) studied the optimization of nutritional and sensory properties in a fermented oat-based composite beverage, providing a relevant methodological precedent for balancing ingredient proportions and consumer preferences. These investigations suggest that the nutritional advantages of plant proteins must be considered alongside their influence on flavor, aroma, texture, and overall acceptability.

The nutritional evaluation of commercially available plant-based beverages has also revealed important differences among formulations. Escobar-Sáez et al. (2022) examined plant-based drinks intended for vegetarian or vegan toddlers, analyzing their nutritional characteristics and potential concerns. Their findings reinforce the importance of evaluating the actual composition

of plant-based beverages rather than assuming nutritional equivalence among products. Consequently, the development of new formulations requires systematic assessment of protein, fat, carbohydrates, fiber, and mineral-related parameters to establish their nutritional characteristics and potential applications.

In parallel, berries have received considerable scientific attention because of their content of phenolic compounds and their potential contribution to the development of foods with antioxidant properties. Tavares et al. (2012) investigated blackberry polyphenols and their neuroprotective potential following simulated gastrointestinal digestion, providing evidence of biological activity under experimental conditions. Van de Velde et al. (2018) examined the anti-inflammatory and wound-healing properties of polyphenolic extracts from strawberry and blackberry fruits. These investigations demonstrate the scientific interest in berry-derived bioactive compounds, although their experimental findings should not be interpreted as direct evidence of clinical benefits from consuming a particular formulated beverage.

Research has also examined the technological applications of berry-derived ingredients in food matrices. Loncarevic et al. (2018) evaluated the incorporation of encapsulated blackberry juice into white chocolate, considering its effects on physical properties, sensory characteristics, and polyphenol content. Diez-Sánchez et al. (2023) reviewed the use of berry pomace in the design of functional foods, highlighting opportunities for incorporating berry-derived components into innovative products. Although these studies focused on different food matrices, they provide useful evidence regarding the technological potential of berry ingredients and the importance of evaluating their effects on product quality.

The color and stability of berry-based products constitute additional considerations in beverage development. Murray et al. (2023) investigated the prediction of color stability in strawberry nectar, emphasizing the relevance of maintaining desirable visual characteristics during processing and storage. Simkova et al. (2023) examined the influence of strawberry fruit size and weight on chemical composition, illustrating the variability of raw material characteristics that may affect food formulation. Furthermore, Petruzzi et al. (2017) reviewed thermal treatments applied to fruit and vegetable juices and beverages, highlighting the importance of processing conditions in relation to product quality and preservation. Together, these studies

support the need to consider both ingredient composition and technological processing when developing beverages containing strawberries and blackberries.

The assessment of antioxidant properties represents another important component of research on fruit-based functional beverages. Giusti et al. (2017) investigated polyphenolic compounds in pulses and their relationship with antioxidant activity and color, demonstrating the relevance of phytochemical characterization in plant-derived foods. The USDA database compiled by Haytowitz and Bhagwat (2010) also provides reference information on the oxygen radical absorbance capacity of selected foods. However, antioxidant measurements obtained through laboratory assays should be interpreted as indicators of chemical activity under specific experimental conditions and not as direct evidence of physiological effects in humans. This distinction is essential when evaluating the potential functional characteristics of newly developed beverages.

Despite the contributions of previous studies, the reviewed literature reveals a need for further investigation into beverage formulations that combine Andean lupin (Lupinus mutabilis Sweet) with strawberries (Fragaria × ananassa) and blackberries (Rubus spp.). Existing research has examined lupin-based beverages, plant protein ingredients, berry-derived bioactive compounds, and the technological characteristics of fruit-based products. However, the combined influence of these three ingredients on sensory acceptability and nutritional composition remains insufficiently addressed within the studies considered. In particular, the balance between lupin concentration and berry content represents a relevant formulation challenge because changes in ingredient proportions may simultaneously affect protein contribution, sensory attributes, and antioxidant characteristics.

Within this context, the present study seeks to contribute experimental evidence through the development and evaluation of three beverage formulations containing different proportions of lupin, strawberry, and blackberry. By integrating sensory assessment, proximate composition analysis, and antioxidant capacity estimation, the research addresses the relationship between ingredient formulation, consumer acceptance, and nutritional characteristics. Its contribution lies in exploring the technological feasibility of combining a traditional Andean legume with locally available fruits to develop a plant-based beverage, while generating preliminary

evidence to support future research on product optimization, stability, safety, and potential functional applications.

Methodology

Experimental design and formulation

Several formulations were developed to determine the feasibility of using Lupin, Strawberry and Blackberry as functional ingredient in a beverage. During this research, an experimental design was applied under a completely randomized design, with four repetitions per treatment. Treatment 1 was made with 25% lupin, 20% red fruits; treatment 2 was prepared with 15% lupin 30% red fruits; treatment 3 contained 5% lupin and 40 % red fruits. The rest of the ingredients, sugar, (4%), vanilla, (0.73%), cinnamon (0.09%) potassium sorbate (0.09%) Xanthan Gum (0.09%) and water (50%), were added in equal proportions to all formulas (Table1).

Raw material

The chocho (Lupinus Mutabilis Sweet) was acquired in the Guamote canton belonging to the province of Chimborazo. Blackberries (Rubus species) and strawberry (Fragaria ananassa), from the Tisaleo canton, belonging to the province of Tungurahua.

Table 1.
Ingredients (g/100) used in the drink

INGREDIENTS	Treatment 1	Treatment 2	Treatment 3
Lupin	25	15	5
Strawberry	10	15	20
BlackBerry	10	15	20
Vanilla	0,73	0,73	0,73
Cinnamon	0,09	0,09	0,09
Potassium Sorbate	0,09	0,09	0,09
Xanthan Gum	0,09	0,09	0,09
Sugar	4	4	4
Water	50	50	50

Products preparation

To prepare the products, Lupin was manually selected, weighed and washed. The seeds were soaked for 12 h as it is general practice in households to soak legume seeds overnight prior to

processing and cooking. The amount of water used for ordinary cooking was three times the weight of the seeds. A thermal treatment was performed on the lupine with water until it reaches a temperature of 80 °C for 1 hour in order to inactivate enzymes, reduce the residual microbial load present and eliminate aromatic compounds that cause the characteristic bitter taste of lupine. After that, the grains were dried in a conventional oven at 100°C for 4 hours.

The dry grain was ground using a food processor (Oster®) to a fine powder and finally passed through a 0.5mm sieve. The strawberries and blackberries were selected with the appropriate ripeness, uniform size, free of pests and without mechanical damage. They were washed with water and disinfected in calcium hypochlorite solution (100 ppm chlorine). The ingredients of each formula were added and processed for 5 min in a blender (Oster). The mixtures were filtered and packaged in individual glass cups, each containing 130 g of the product, sealed with a metallic cover and immediately autoclaved at 1210C for 15 min.

Sensory analysis

The sensory evaluation was carried out based on what was stipulated by the ISO 6658 to determine the treatment with greater acceptability using a panel of thirty untrained judges to whom properly prepared samples of the three treatments under study were given. The attributes to be analyzed were acceptability, color, smell, appearance and flavor, for which a five-point hedonic scale was used, where values of one and five indicate the lowest and highest acceptance of the product respectively. To determine the treatment with greater acceptability, a simple affective acceptance test was used, remembering that the taster is given the three samples duly coded to later indicate which of them he prefers. Samples (50 ml) of each treatment were served in random order to the panelists, isolated in partitioned booths illuminated with white fluorescent light. Glass of water was provided between the samples to clean the palate.

Proximal composition

The content of proteins, fat, crude fiber, ashes and humidity of the treatment 3 were determined following the method established by the Association of Official Analytical. (AOAC, 2000). The carbohydrate content was calculated by difference to achieve 100% of total content. The metabolic energy was determined using the empirical method proposed by Livesey (1995). The antioxidant capacity of the formulated product was estimated using the United States

Department of Agriculture's Oxygen Radical Absorbance Capacity (ORAC) Database of Selected Foods (USDA 2010).

Statistical analysis

The results obtained were processed with the Infostat statistical program and then subjected to an analysis of variance for the difference between treatments. The Tukey test for comparing the means was used when the main effects resulted to be significant ($P<0.05$).

Results and Discussion

Sensory evaluation

Table 2.
Sensory analysis of beverages formulated with Lupin and berries

Atributes	T1*	T2*	T3*
Acceptability	2.23^{c}	3.13^{b}	4.40^{a}
Appearance	2.73^{b}	3.27^{ab}	3.80^{a}
Color	2.37^{c}	3.43^{b}	4.33^{a}
Smell	3.03^{b}	3.72^{a}	4.17^{a}
Flavor	2.73^{c}	3.37^{b}	4.40^{a}

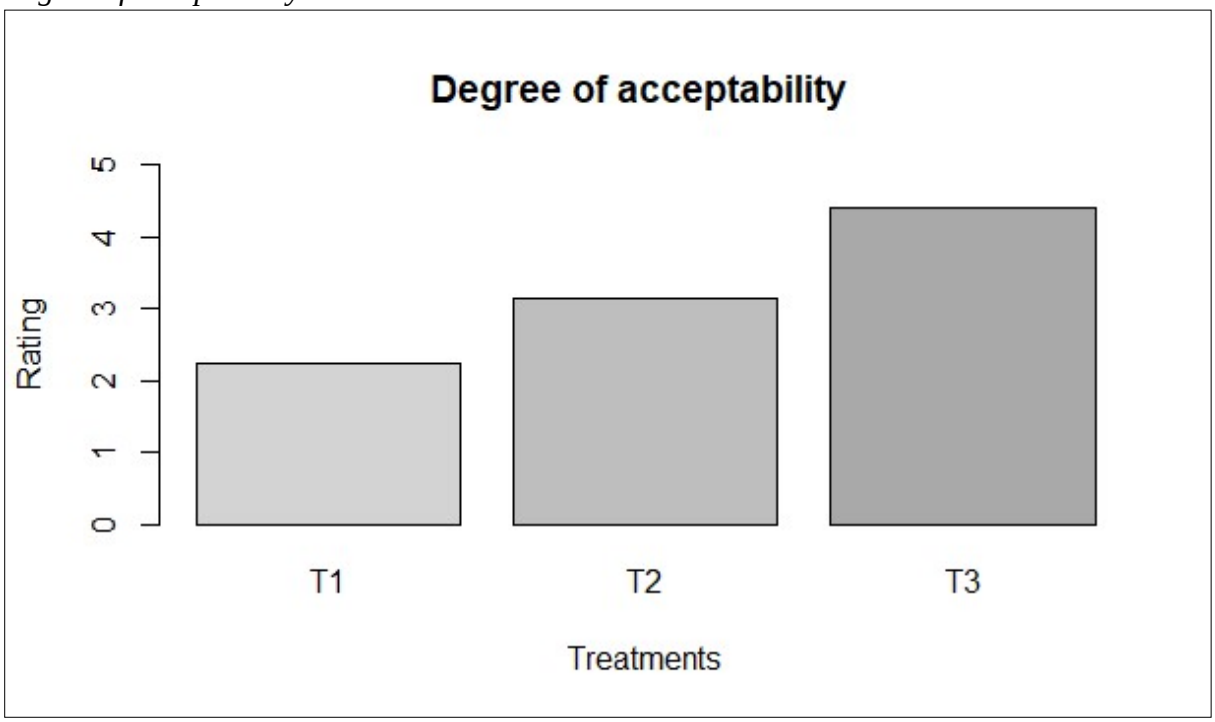
a, b, c Means with different superscripts within a row differ significantly ($P<0.05$). * T1: 25% Lupin 20% red fruits T2: 15% Lupin 30% red fruits T3: 5% Lupin 40% red fruits.

The results of the attributes evaluated for each of the treatments are seen in Table 2. From the data shown in the table, the analysis indicated that there are significant differences ($p>0.05$) between the different treatments. It is observed that T3 was the one that had the highest (4.40) preferences by the untrained panel because it is the formula with lower content in lupine, where the "frijolado" flavor is less perceptible compared to the others. Firew et al. (2022) produced a fermented drink based on oats and lupine, obtaining a minimum score of 3.3 and a maximum of 4.3 by varying the percentages of the aforementioned products, where the treatment with 70% oats and 10% lupin was of greater preference than the others.

Similar data were obtained in the present investigation, which is due to the fact that in both drinks there is an interest due to the raw materials used in the production of the product. According to Oliveira et al. (2023), the use of lupine in the food industry draws a lot of attention from consumers since it is considered a functional food or a super food because it has vegetable proteins of high biological value, therefore it will always be taken into account as a substitute

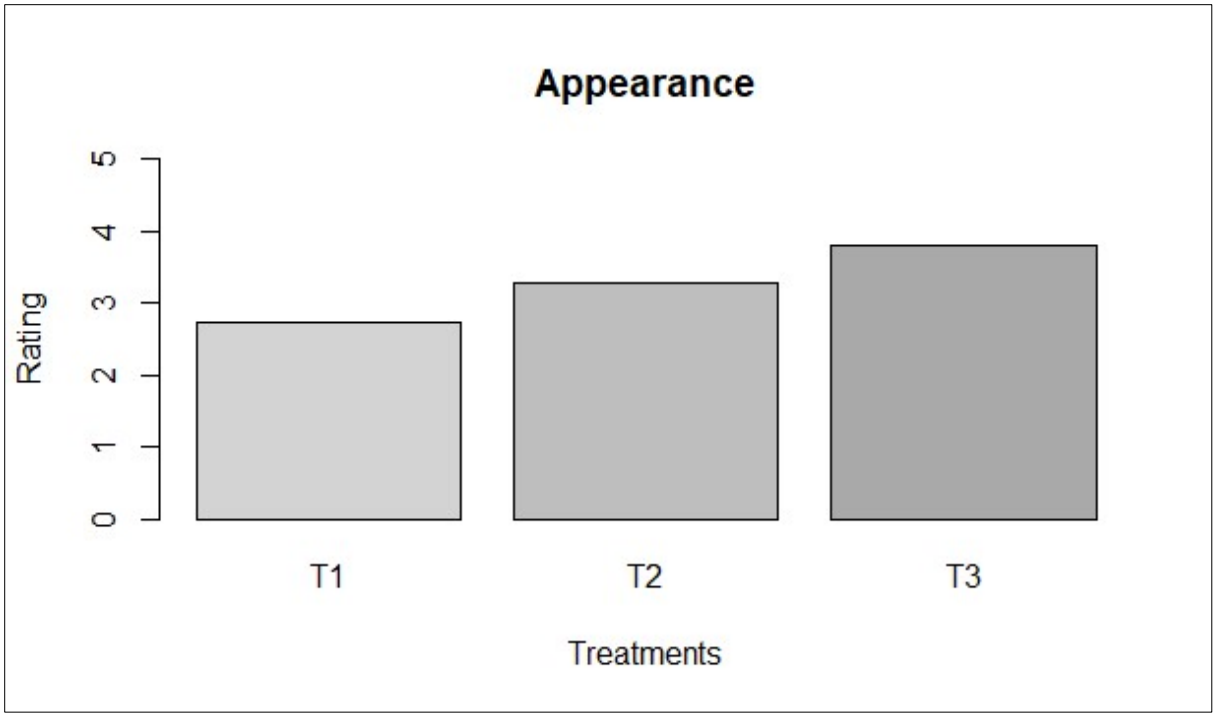
alternative to foods that contain raw materials of animal origin. Figure 1 shows degree of acceptability.

Figure 1.
Degree of acceptability.



When evaluating the appearance of the treatments (Figure 2), significant differences were evident between treatment one and three, where the best score was obtained by treatment three (40% red fruits/berries and 5% lupine) with a score of 3.80 points out of 5. points, which is due to the fact that the chocho directly influences the consistency of the drink since it was crushed for use, making it thick due to the amount of fiber it contains and therefore it was not very acceptable by consumers. Similar results in the assessment of this parameter were reported by Firew et al. (2022) when making a drink with 15% lupine and 62.5% oats, obtaining a rating of 3.7 points out of 5 points, who also indicate that the appearance depends on the raw materials used and the previous treatment given to them before adding them to the product mixture.

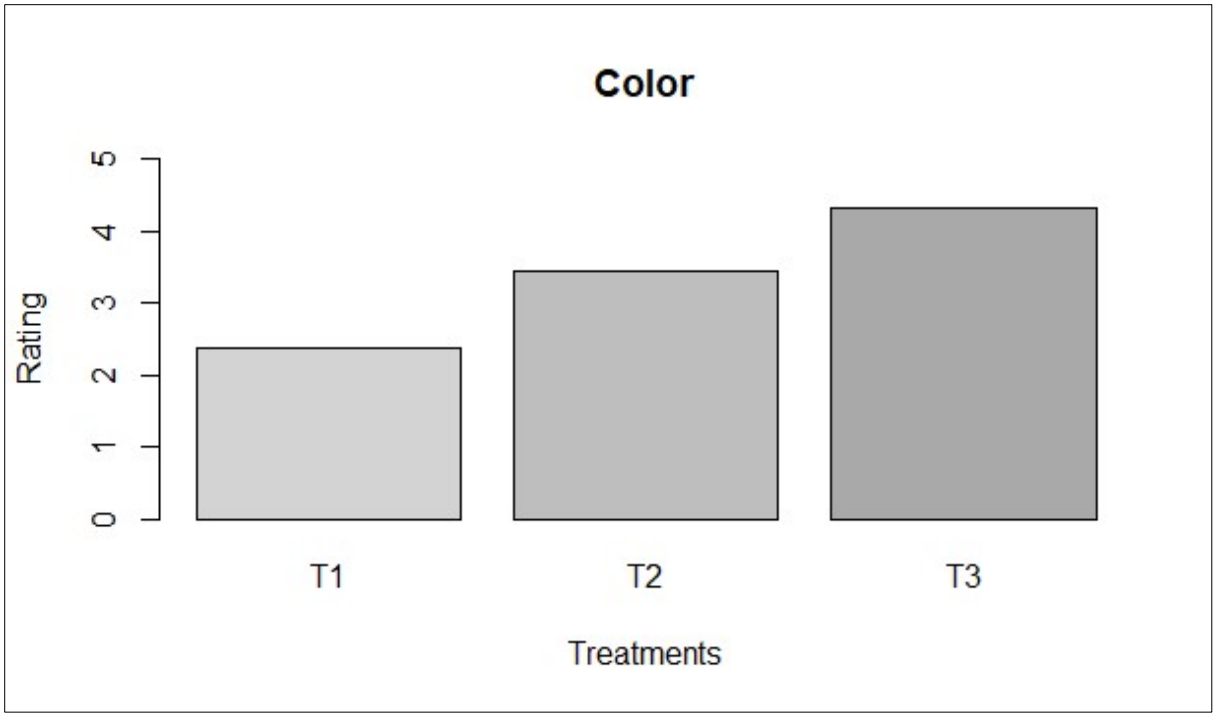
Figure 2.
Appearance of the drink



Escobar et al. (2022) points out that vegan drinks are a substitute for dairy drinks that can be consumed by people who are lactose intolerant or who have some other type of allergic reaction after consuming milk. Although it is also concluded that what captures the attention of this market segment is the appearance of vegan drinks since these are similar to dairy drinks, and in the case of this research, the fact of having berries also stands out, since it relates it to an organic product without added artificial colors or flavors.

It is appropriate to mention that, one of the important aspects in fruit drinks is color, since it is visualized at first glance by consumers. The results show that there were significant differences between the treatments (Figure 3). The highest score is recorded for treatment three with a value of 4.33 points out of 5 points, which means that the percentage of berries used in the formulation has a direct influence and favorably generating a good visual impression of the manufactured product. Studies performed by Zuelch et al. (2023), point out that the characteristic color of red fruits is due to the presence of proanthocyanins, ellagitannins and anthocyanins, so when placed in drinks a coloration is obtained that attracts the attention of consumers.

Figure 3.
Drink color



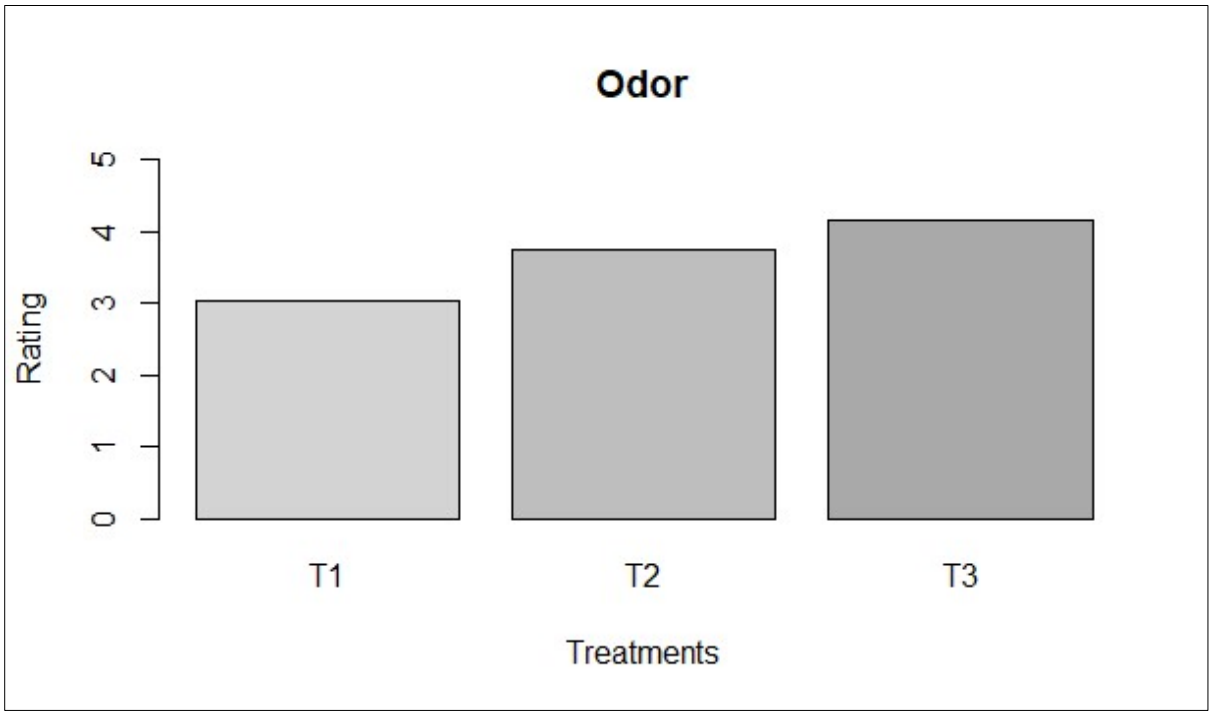
Murray et al. (2022) indicates that the color of the strawberry is due to the presence of anthocyanin pigments such as pelargonidin 3-glucoside and cyanidin 3-glucoside, and in the case of blackberry (Park et al., 2022) it has cyanidin-glucoside, and that although a heat treatment is performed on products that contain both fruits, the color is not completely lost, as happened in the present investigation. For Olaimat et al. (2023) color is a highly relevant sensory attribute which is influenced by the percentage of raw materials and inputs used in cookie formulations, since due to them a series of biochemical reactions are produced that provide pleasant colors and flavors to the product.

When evaluating the smell of the three treatments, significant differences were evident with treatment one (20% red fruits and 25% lupine) and a greater preference by the judges in treatment three with a rating of 4.17 points over 5 points, which is due to the fact that the treatment in question contains the highest percentage of red fruits in its formulation and consequently their aromatic compounds provide the characteristic and pleasant smell perceived by the judges.

Similar results have been reported by Firew et al. (2022) in his work on chocho-based drink, with an average between 3 to 3.5 points out of 5 points, because they added oats and nettle flour

in their formulation, corroborating that the amount of raw materials and inputs added significantly influence all the sensory attributes of a product. Figure 4 shows the results obtained when evaluating the difference between the treatments with respect to smell.

Figure 4.
Drink Odor



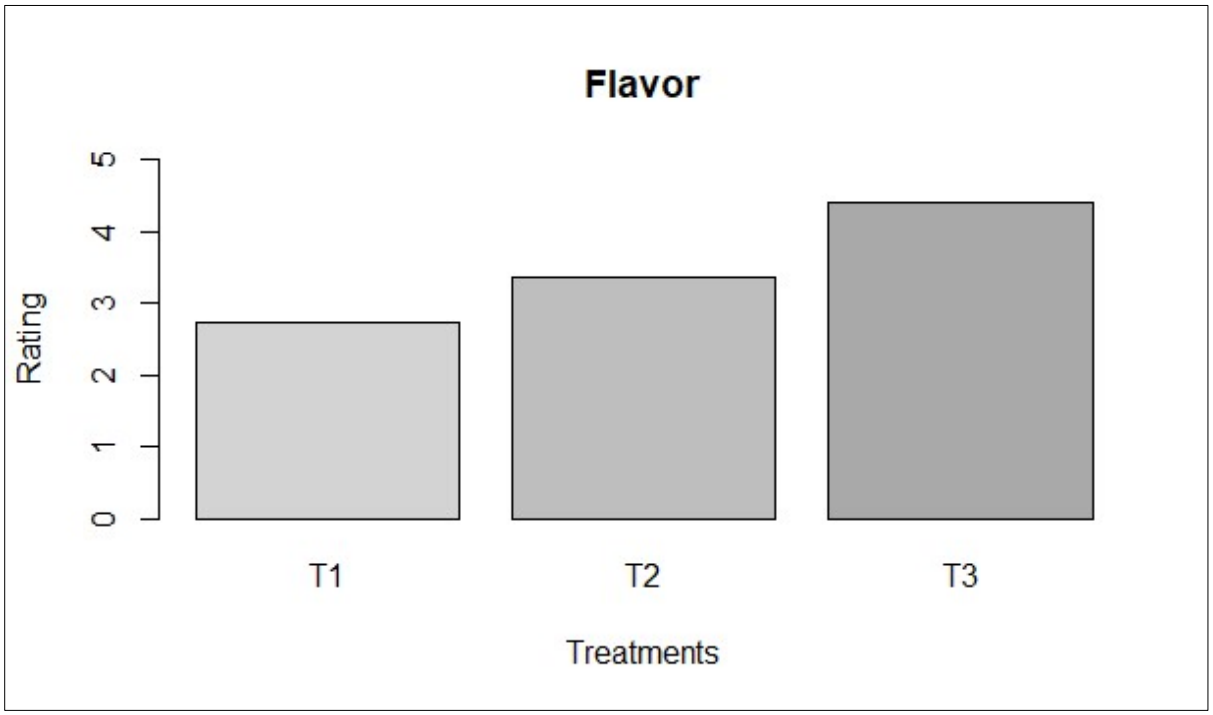
For Laaksonen et al. (2021) using legumes or other protein products of plant origin as raw material for the production of other types of products is not highly recommended because they may present unpleasant sensory attributes. However, Firew et al., (2022) conclude that making lupine-based drinks together with other types of raw materials and additives considerably favors the sensory attributes of the drink, overshadowing the lupine flavor, thereby avoiding rejection of the product by consumers. The same trend was evident in the present investigation, since red fruits were added to the drink, improving the sensory attribute in question and which is reflected in the results obtained.

The mean taste values for the beverages were in the range of 2.73-4.40 (Table 2) and the results showed a statistically significant variation. Red fruit provide a pleasant flavor to the consumer and enhance the sensory quality of the beverage produced. The results obtained agree with those of Firew et al. (2022), who rated the flavor of a vegan drink with 25% lupine and 60% oats at 4.5 points out of 5 points. This significantly influenced the flavor of the product, as in the

present research where berries were added that enhanced the flavor of the drink by overshadowing the characteristic residual flavor of chocho, whose bitterness is not very desired by consumers. Figure 5 shows the scores obtained.

Research carried out by Escobar et al. (2022) indicate that drinks based on vegetable raw materials have a pleasant flavor and appearance depending on the type of product used for their production. Therefore, an adequate interaction must be performed between the raw materials and inputs to be added since this depends on the acceptance or rejection of the product by consumers.

Figure 5.
Drink Flavor



Proximal composition

Table 3 shows the mean values for moisture, protein, fat, available carbohydrates, fibre, ash and caloric energy of the treatment with highest score on sensory assessment (T3). The results show that the moisture content was 80.50±0.2 this result is similar to the presented by Cerezal et al. (2012) who reported values of 83,68 ± 0,05 in the development of a beverage made with lupine and quinoa for the diet of pre-schoolers. Likewise, Tiencheu et al. (2021) show similar

results (79.31%) in natural juices formulated with orange, lemon, honey and ginger. Similarly, Ohwesiri et al. (2016) obtained moisture values closely related to this study (82.48–88.35%).

Table 3.
Proximal composition of the drink made with Lupin, Strawberry and BlackBerry (T3)

Variables	g/100 ml*
Moisture	80.50±0.2
Ash	0.90±0.2
Protein	1.52±0.2
Fat	0.92±0.12
Carbohydrates	16.16±0.14
Caloric energy**	79
Fibre	0.27±0.3

* Arithmetic average value ** Kcal /100 g product

Fruit and vegetable drinks, depending on the fruit and vegetable used, have many minerals, which play an important role in overall body functions (Petruzzi et al., col., 2017). In this sense, the contribution of ashes of the formulated beverage was 0.90, which is within the expected bibliographic range of between 0.3 - 2% for fruit and vegetable drinks (Belitz and Grosch, 1999) and agrees with the results (0.55 and 0.88%) obtained from beverages formulated with oranges, tomatoes and carrots (Adubofuor et al., 2010).

It is important to mention that the protein (1.52%) provided by the drink under study is represented to a high degree by lupine. This result is consistent with the values (1.97, 0.54, and 2.33) reported by Escobar et al (2022) in pasteurized beverages formulated with almonds, coconut and oats. In the same way, Cerezal et al. (2012) reported a protein percentage of 1.33% in their drink based on lupine and quinoa. Rehab (2023) points out that lupine is one of the most nutritious sources of amino acids compared to other legumes, and since it has essential amino acids, its adequate consumption not only gives the feeling of satiety, but also contributes mainly to the formation of structures.

The formulated drink had a fat content of 0.92%. Oliveira et al. (2023) obtained a similar value (0.90%) in a lupine hydrolysate. Lower values ranging from 0.05 to 0.11g/100ml have been reported in several beverages formulated with different fruits (Amin et al., 2018, Tiencheu et al., 2021). In the present investigation, the addition of berries does not significantly increase the total fat content of the drink because they are very poor in this nutrient.

The fiber content of the beverage formulated with Lupin, strawberry and blackberry obtained a value of 0.27%. Similar results (0.13%) were reported by Cerezal et al. (2012). It should be added, that drinks containing fruits are high in carbohydrates, easily metabolized mainly dextrose such as fructose and/or glucose (Akusu, 2016). As can be seen, the carbohydrate content of the drink was 16.16% values very close (16.39 -22.99%) to those reported by Tiencheu et al. (2021).

Table 4.
The Oxygen Radical Absorbance Capacity (ORAC) of beverage prepared with Lupine, strawberry and blackberries.

INGREDIENTS	VALUE OBTAINED
Strawberry	860.4 µmol ET
Blackberries	1069.4 µmol ET
Cinnamon	240 µmol ET
Legume	76 µmol ET
Total	2245.8 µmol ET

*Value expressed in 100 ml of beverage.

The Oxygen Radical Absorbance Capacity (ORAC) of foods is considered a measure of total antioxidant activity in a specific food product that results from the presence of a number of chemical compounds in foods that act as antioxidants. Oxidative stress is considered to be a contributing factor in the aging process and in the development of various chronic and degenerative diseases. Dietary antioxidants may have a role in reducing oxidative stress and thus reduce the risk of these diseases (Haytowitz, and Bhagwat 2010). As expected, the antioxidant capacity of the drink was high, obtaining a value of 2245.8 µmol ET (Table 4). Lemus et al. (2023), it is mentioned that the antioxidant properties of lupine are due to its content of phenolic compounds, where Gallic acid stands out, which prevents oxidative stress and therefore eliminates free radicals that are associated with cancer.

In accordance with Lemus et al. (2023), the content of phenolic compounds in lupine ranges between 535.1 and 578.4 mg/100 g. The blackberry and strawberry stands out among the fruits evaluated by exhibiting the highest antioxidant activity and the highest levels of phenols, flavonoids and anthocyanin. The major polyphenolic compounds in berries are anthocyanins, hydrolyzable tannins (gallo- and ellagitannins), flavonols, and flavan-3-ols, including proanthocyanidins (The major polyphenolic compounds in berries are anthocyanins,

hydrolyzable tannins (gallo- and ellagitannins), flavonols, and flavan-3-ols, including proanthocyanidins (Van Velde et al., 2018).

Conclusiones

Treatment three presents greater sensory acceptability with 40% red fruits and 5% lupine obtaining a score of 4.40 out of 5 points from the judges. The protein, fat and total fiber content of the best-evaluated drink is 15.7%; 0.92% and 0.27% respectively, so it is considered a balanced source of nutrients. The antioxidant capacity of the drink was of 2245.8 µmol ET which provides phenolic compounds that inhibit the development of free radicals.

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Final Declarations

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