The Effect of Adding Reishi Mushroom and Lion's Mane Mushroom on the Qualitative and Sensory Properties of Laboratory-Made Biscuits

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Abstract

This study aims to fortify oat and lentil-based biscuits with Reishi and Lion's Mane mushroom powders to enhance their nutritional and sensory attributes. Significant improvements were observed in protein, fiber, and vitamin contents, particularly in Lion's Mane treatments. Sensory analysis revealed higher acceptability with Lion's Mane additions. These findings suggest the potential for functional food innovation using medicinal mushrooms.. The results demonstrated that the two types of mushrooms had high nutritional content. Protein levels reached (2.40%, 2.18%), fat content in reishi mushroom was (6.56%), and carbohydrates were higher in lion's mane mushroom (71.97%). Calcium and iron values were (81, 89) µg/gm, which enhanced the nutritional value of the laboratory-made biscuits with oats and lentils. Protein content increased in treatments (C3, A3) to (2.40%, 2.09%), while carbohydrates rose in (C3, A3) to (58.60%, 63.32%). Potassium (K) content increased in (C3, A3) to (95.00, 99.07) µg/gm. Among the prominent vitamins, vitamin K significantly increased in treatment C3, reaching (14.55) µg/gm. There were no significant changes in the physical properties of the product compared to the control treatment. Sensory acceptance improved for the biscuits with lion's mane mushroom, particularly in most attributes such as appearance, texture, color, softness, and overall acceptability. The highest sensory scores were observed in treatment C3: (5.70) for appearance, (5.60) for softness, (5.70) for color, and (5.30) for overall acceptability compared to the control treatment. This indicates that biscuits with lion's mane mushroom outperformed in all sensory and nutritional attributes.

Keywords: Reishi mushroom, Lion's mane mushroom, Biscuits, Powder, Sensory acceptance.

Introduction

Fungi have been widely described in

traditional Chinese medicine due to their proven benefits to human health [30]. These types of fungi are found worldwide, particularly in the Northern Hemisphere, including North America, Europe, and Asia. The lion's mane mushroom (Hericium erinaceus) has been recognized as an important medicinal fungus, with its numerous bioactive compounds developed into alternative medicines and dietary supplements [17]. It is classified as a fungus because it relies on other organisms for survival, living parasitically [14]. Fungi, including fermented types, are characterized by the presence of several biologically active molecules, such as proteins, lectins, polysaccharides, terpenoids, and phenolics. This demonstrates their antifungal potential [23]. The lion's mane mushroom contains two categories of terpenoid compounds derived from its fruiting bodies and cultured fungi[18, 30. [

Lion's mane mushroom can be considered an important functional food in terms of nutrition and is also a primary source of physiologically active drugs. It has been used for long periods,

and has also been used in ancient Chinese medicine, as it contains many important components, the most important of which is the polysaccharide beta-glucan, which plays an important role in increasing immunity, and also protects the nerves, provides antioxidant properties, lowers cholesterol, resists high blood pressure, acts as an antimicrobial agent, and promotes wound healing. [19]. This substance also protects the liver as well as the heart, as it is a unique substance with many benefits for human health [20]. In addition, the mushroom contains a high percentage of minerals, proteins, and vitamins[31.[

It contains a lot of fiber that is free of fat and cholesterol [22] thanks to which it can help protect the heart and arteries as well as reduce the risk of diabetes, which are two of the main causes of death in the countries of the Western Pacific and Asia. [4.[

Reishi mushroom (Ganoderma lucidum) is also known as a woody fungus that grows rotting on tree trunks [27] and is classified as a basidiomycet This mushroom is also distinguished by its size and is a member of a unique genus . This mushroom has been used for more than 2000 years to boost immunity and prolong life expectancy, especially in Asian countries such as China and Japan [12,26. [

Many studies have shown that Reishi mushroom has significant economic and health benefits. However, its hardness prevents its direct consumption [24]. Due to its high dry matter content and abundance of active chemicals, the mushroom has great nutritional value. According to [9], Reishi mushroom is not only a nutritious food but also a major ingredient in more than 200 different types of medicines[33.[

Reishi mushroom is an important natural product and also a nutritional supplement for regulating body functions, which is greatly supported by a number of scientific studies [28]. It has also been used in the pharmaceutical industry as a raw material; more than 6000 tons are produced annually [8]. One sustainable way to increase the nutritional value of mushrooms and create affordable products is to use them in baked goods] 27[More than 58.2% of them are complex carbohydrates. However, when compared to grains, legumes have a relatively low carbohydrate content. Legumes also contain vitamins B1 and B2, as well as minerals including potassium, calcium, and iron [11]. Since grains are rich in minerals, especially iron, and vitamins B1, B2, and B6, their production is expected to reach 7.14 million tons worldwide. Similar to the two families, cereals and legumes are relatively low in fat [21]. Given the importance of adding nutrient-rich natural ingredients to foods, the present study aimed to create laboratory-made biscuits that were high in fiber, protein, minerals, and vitamins. The biscuits were fortified with different amounts of Reishi and Lion's Mane mushroom powders. Comparing the laboratory-made biscuit treatments and assessing their nutritional content were additional objectives of the study.

Materials and Methods

Reishi and Lion's Mane mushrooms are obtained in Iraq from several nurseries in Baghdad. The mushrooms are dried, crushed and ground using a grinder to produce the powder used in the biscuit recipe.

Biscuit Preparation

The standard method described by [10] was followed for preparing laboratory-made biscuits, with some modifications to the ingredients used.

.1Procedure

Lentil flour, oat flour, baking powder, and salt were sieved together in a mixing bowl. The oven temperature was set to 218°C (425°F).

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Solid fat was added to the dry ingredients using the cutting method. Liquid milk was then added to the dry mixture, and all ingredients were mixed thoroughly with a fork approximately 30 times until the dough became uniform. The rolling pin and wooden board were dusted with flour, and the dough was rolled out to a thickness of 0.5 cm. The dough was cut into circular shapes using a biscuit cutter with a diameter of 5 cm.

.2Standard Biscuit Treatments

Lentil flour and oat flour were used as substitutes for regular flour in the following treatments:

.1 Treatment Y: 100 g of flour was replaced with 50 g of lentil flour and 50 g of oat flour, while the other ingredients were used as in the original recipe.

.2 Treatment A1: 49.5 g of lentil flour, 49.5 g of oat flour, and 1 g of reishi mushroom powder were used.

.3 Treatment A2: 48.5 g of lentil flour, 48.5 g of oat flour, and 3 g of reishi mushroom powder were used.

.4 Treatment A3: 47.5 g of lentil flour, 47.5 g of oat flour, and 5 g of reishi mushroom powder were used.

.5 Treatment C1: 49.5 g of lentil flour, 49.5 g of oat flour, and 1 g of lion's mane mushroom powder were used.

.6Treatment C2: 48.5 g of lentil flour, 48.5 g of oat flour, and 3 g of lion's mane mushroom powder were used.

.7Treatment C3: : 47.5 g of lentil flour, 47.5 g of oat flour, and 5 g of lion's mane mushroom powder were used.

.3Chemical Determinations

The chemical composition of the laboratory-made biscuits was analyzed using standard methods described in [1] as detailed below:

.1 Protein Determination

The protein content of the samples was determined using the Kjeldahl method. The total nitrogen percentage was measured and multiplied by the factor 6.25 to calculate the protein percentage.

.2 Ash Determination

Ash content was determined by incinerating the sample in a muffle furnace at 525°C until the color changed to grayish-white. This provided the ash content of the sample.

.3 Moisture Determination

Approximately 2–3 g of each sample was placed in a pre-weighed crucible and heated in an electric oven at 105°C until a constant weight was achieved. After cooling, the crucible was weighed to calculate the moisture content.

.4 Fat Determination

Fat content was extracted using the Soxhlet apparatus with petroleum ether as the solvent.

.5 Carbohydrate Determination

Carbohydrate content was calculated by difference, subtracting the percentages of protein, fat, moisture, and ash from 100%.

The percentage of carbohydrates was calculated using the following formula:

[29]

.6 Crude Fiber Determination

The crude fiber content was determined by digesting the food sample (after fat extraction) with 1.25% sulfuric acid and 1.25% sodium hydroxide. The residue left after digestion was filtered, dried, and incinerated. The remaining material consisted of crude fiber along with insoluble ash and some moisture. After drying and incineration, the weight of the burned residue was used to determine the crude fiber by applying the following formula:

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.7Mineral Content Determination

The minerals iron, calcium, magnesium, potassium, copper, and zinc were determined using an Atomic Absorption Spectrophotometer (Perkin Elmer, model VSA500) following the method described in [7.[

.8Vitamin Determination

To identify vitamins, two solutions were prepared:

An aqueous solution of lithium perchlorate ($LiClO_4$) with the pH adjusted to 2.4.

A solution consisting of 0.1% butylated hydroxytoluene (BHT) in methanol

- Sensory Evaluation

The sensory evaluation of the biscuit samples was conducted by 10 assessors from the Faculty of Education for woman, Department of Home Economics, University of Baghdad, all specializing in food and nutrition. The evaluation process is carried out for each of the following attributes: color, flavor, freshness, appearance, texture, ripeness, and general acceptability, based on the model designed by the US Food and Drug Administration [13.[

Statistical Analysis

Many of the results were also analyzed statistically using the [25] statistical analysis system to analyze the data to find out the effect of different treatments on all the studied traits. Complete block designs (RCBD) were also applied, and the differences between the averages were compared using the least significant difference (LSD) test.

Chemical Composition of Reishi and Lion's Mane Mushrooms

The chemical properties of the two mushrooms is displayed in Table (1). The lion's mane had a higher protein level than the reishi, coming in at 2.40% and 2.18%, respectively. Because of variations in their physical characteristics, such as their ability to absorb water, which influences the density of the mushroom and its protein content, the protein content of mushrooms varies according to the type of media they are grown on [3]. In terms of moisture content, the lion's mane has higher values (11.13%) than the reishi (10.40%). With readings of 6.56% and 1.16%, respectively, the reishi's fat content was significantly higher than that of the lion's mane. Furthermore, the amount of carbohydrates was noticeably greater in the reishi (43.45%) in contrast to the lion's mane (71.97%). Depending on the kind of host the mushrooms were cultivated on, the percentage of carbohydrates in their fruiting bodies varied from 30.06% to 63.70%, according to a study by [18] At 36.69%, the fiber content of Reishi was far higher than that of Lion's Mane, which was 7.74%. Additionally, the ash concentration varied, with Reishi having a larger percentage (7.72%) than Lion's Mane (5.60%). The chart makes it evident that both mushrooms are abundant in nutrients since they contain active chemicals that are crucial for boosting immunity. The two mushrooms' different environments and growing conditions are probably the cause of the compositional variances [5.[

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Table 1. The Chemical Composition of Reishi and Lion's Mane Mushrooms.

Sample	Protein %	Moisture %	Ash %	Fat %	Carbohydrates %	Crude Fiber %
Lion's Mane	2.40	11.13	5.60	1.16	71.97	7.74
Reishi	2.18	10.40	7.72	6.56	43.45	36.69

Mineral Content of Reishi and Lion's Mane Mushrooms

From Table (2), it is clear that the mineral content of the two mushrooms shows that the levels of K, Zn, and Fe were higher in Lion's Mane, with values of 89, 48.5, and 81 µg/gm, respectively. In comparison, Reishi showed values of 51, 39.88, and 53 µg/gm for K, Zn, and Fe, respectively.

As for Mg and Ca, the difference was slight, with Reishi having higher levels than Lion's Mane, averaging 31 and 35 µg/gm, respectively, compared to 30 and 32 µg/gm for Lion's Mane.

From this table, we observe that both mushrooms contain a good amount of essential minerals that serve as immune-boosting agents, antioxidants, and antimicrobial agents [16.[

Table 2. which shows the mineral content of Reishi and Lion's Mane mushrooms in µg/gm.

Sample	Fe (µg/gm)	Zn (µg/gm)	Ca (µg/gm)	Mg (µg/gm)	K (µg/gm)
Lion's Mane	89	48.5	32	30	81
Reishi	51	39.88	35	31	53

Vitamin Estimation for Reishi Mushroom and Lion's Mane Mushroom

Table No. (3) shows that Lion's Mane Mushroom has a higher content of vitamins (V.C, V.D, V.E, V.K, V.A) compared to Reishi Mushroom. The levels reached (13.00, 17.11, 10.55, 14.33, 12.35) µg/gm, respectively, for

Lion's Mane, while Reishi Mushroom had (11.01, 14.04, 9.16, 12.00, 10.20) µg/gm, respectively. [15]. Vitamin A was found to be higher in Reishi Mushroom (11.201 µg/gm). This demonstrates the high value of Lion's Mane Mushroom in vitamins that are beneficial for heart disease, cardiovascular health, and diabetes [4.[

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Table 3. Vitamin Content in Reishi and Lion's Mane Mushrooms (µg/gm.(

Sample	V.C (µg/gm)	V.D (µg/gm)	V.E (µg/gm)	V.K (µg/gm)	V.A (µg/gm)
Lion's Mane	13.00	17.11	10.55	14.33	12.35
Reishi	11.01	14.04	9.16	12.00	10.20

Chemical Composition of Laboratory-Made Biscuit Treatments

Table No. (4) shows significant differences at the statistical level ($P \leq 0.05$). The nutritional value of the biscuits increased after adding Reishi Mushroom and Lion's Mane Mushroom in different proportions to the biscuits made from lentils and oats. A significant increase in protein content was observed in the biscuit treatments with Lion's Mane Mushroom (C3, C2, C1), which were (2.18, 2.53, 2.09) % compared to the control treatment (1.09) %. The protein content also increased in the biscuits with Reishi Mushroom in treatments (A3, A2, A1), which were (1.35, 2.18, 2.40) %, showing a noticeable increase, which matches the study by [2]. There was also a significant increase in carbohydrate content in the treatments (A3, A2, A1) with values of (64.25, 58.60, 57.74) % compared to the control treatment (57.04) %. For treatments (C3, C2, C1), the carbohydrate content reached (59.55, 60.50, 63.32) % compared to the control treatment. Additionally, there was a significant increase in fiber content in the biscuit treatments. In treatments (A3, A2, A1), fiber content increased to (5.70, 5.82, 7.17) % compared to the control treatment (5.23) %, while in treatments (C3, C2, C1), it was (5.42, 5.03, 5.98) % compared to the control treatment, with a slight difference from the biscuits with Reishi Mushroom. A slight change was observed in the moisture content of the biscuit samples compared to the control treatment. In treatments (C3, C2, C1), the moisture content was (9.40, 10.02, 10.71) %, while in treatment (A1), it decreased to (6.25) % compared to the control treatment (9.33) %. However, moisture content increased in treatments (A2, A3) to (10.13, 10.29) % respectively. A noticeable decrease in fat content was observed in all samples compared to the control sample, which had a fat content of (24.30) %. In treatments (A3, A2, A1), fat content was (19.11, 20.33, 21.20) %, while in treatments (C3, C2, C1), fat content decreased to (20.34, 21.16, 18.65) %. Despite the fact that the fat in both types of mushrooms is of high quality and beneficial due to its effective role, it decreased due to the increase in fiber and ash content, which increased in the treatments compared to the control treatment, which had (3.01) % ash content. In treatments (A3, A2, A1), ash content was (3.16, 3.39, 3.20) %, and in treatments (C3, C2, C1), it was (3.11, 3.80, 3.23) %, indicating the presence of beneficial minerals that helped increase the nutritional value of the biscuits.

From the above, it is clear that each treatment with its respective mushroom contains high nutritional values, providing each mushroom with its own nutritional benefits.

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Table 4. Chemical Composition of Experimental Biscuit Formulations.

Average ± Standard Error						
Sample Code	Crude Fiber (%)	Carbohydrates (%)	Oil (%)	Ash (%)	Moisture (%)	Protein (%)
Y	5.23 ± 0.006 d	57.04 ± 0.006 f	24.30 ± 0.003a	3.01 ± 0.005 e	9.33 ± 0.006 f	1.09 ± 0.005 a
A1	5.70 ± 0.01 b	64.25 ± 0.01 a	19.11 ± 0.26 d	3.16 ± 0.01 c	6.25 ± 0.01 g	1.53 ± 0.01 d
A2	5.82 ± 0.01 e	58.60 ± 0.11 e	20.33 ± 0.01 c	3.93 ± 0.01 f	10.13 ± 0.01 a	2.18 ± 0.01 c
A3	7.17 ± 0.01 a	57.74 ± 0.01 g	21.20 ± 0.01 b	3.20 ± 0.01 b	10.29 ± 0.01 c	2.40 ± 0.01 b
C1	5.42 ± 0.005 c	59.55 ± 0.005 d	20.34 ± 0.005 c	3.11 ± 0.005 d	9.40 ± 0.005 e	2.18 ± 0.006 c
C2	5.03 ± 0.003 f	60.50 ± 0.05 c	21.16 ± 0.005 b	3.80 ± 0.005 g	10.02 ± 0.005 d	2.53 ± 0.005 d
C3	5.98 ± 0.003 g	63.32 ± 0.005 b	18.65 ± 0.005 e	3.23 ± 0.005 a	10.71 ± 0.008 b	2.09 ± 0.01 e
LSD Value	0.025 *	0.146 *	0.299 *	0.0265 *	0.027 *	0.0265 *

Note: Means with different letters within the same row are significantly different.($P \leq 0.05$.(

Determination of Mineral Content in Laboratory-Made Biscuit Samples

From Table No. (5), one can observe a significant increase in the nutritional value of the biscuit samples to which different amounts of the two mushrooms were added. A clear increase in all minerals was observed across all treatments. The average increase in potassium content was as follows: in treatments (A1, A2, A3), the values were (95.00, 94.00, 93.00) µg/gm respectively, compared to the control treatment, which had (91.67) µg/gm. Potassium levels increased even more in treatments (C1, C2, C3), with values of (99.07, 97.70, 92.07) µg/gm respectively. A noticeable increase in magnesium content was also seen in treatments (C1, C2, C3), reaching (47.00, 45.06, 43.00) µg/gm, compared to the control treatment which had (38.66) µg/gm. In Reishi mushroom biscuits, the highest increase in magnesium was in treatment (A3), reaching (42.00) µg/gm. Similarly, calcium content increased, reaching (84.00) µg/gm in treatment (A3) and (85.06) µg/gm in treatment (C3), compared to the control treatment which had

(78.00) µg/gm. Zinc content increased to (56.01) ppm in treatment (A3) and (59.24) ppm in treatment (C3), compared to the control treatment, which had (53.00) µg/gm. Regarding iron, the levels increased in all treatments, reaching (79.00, 85.21) µg/gm in treatments (A3, C3) respectively.

From the above results, one observes a significant increase in the mineral content of the biscuits ($P \leq 0.05$), due to the high mineral content of the two mushrooms, which enhanced the nutritional value of the biscuits, especially in the Lion's Mane mushroom biscuit treatments, due to their higher mineral content. This is consistent with the study by [2], where mineral values increased in biscuit treatments as the addition ratios increased. The potassium values were (993.00, 92.70, 92.35) µg/gm, respectively, and magnesium values were (40.06, 39.33, 39.20) µg/gm.

Table 5. Estimation of Mineral Content in Laboratory-Made Biscuit Treatments (µg/gm.(

Average ± Standard Error					
Sample Code	Fe/ppm	Zn/ppm	Ca/ppm	Mg/ppm	K/ppm
Y	74.00 ± 0.57 a	53.00 ± 0.57 a	78.00 ± 0.57 a	38.66 ± 0.33 a	91.67 ± 0.33 a
A1	76.83 ± 1.61 b	54.40 ± 0.005 e	80.00 ± 1.15 b	39.00 ± 1.15 cd	93.00 ± 1.15 ab
A2	77.70 ± 0.35 ab	55.81 ± 0.005 d	83.00 ± 1.15 b	41.00 ± 1.15 bc	94.00 ± 1.15 bc
A3	79.00 ± 0.06 ab	56.01 ± 0.003 c	84.01 ± 1.15 c	42.00 ± 1.15 d	95.00 ± 0.06 c
C1	78.07 ± 0.12 ab	53.20 ± 0.003 e	80.03 ± 0.08 b	43.00 ± 0.06 b	92.07 ± 0.12 bc
C2	82.01 ± 0.003 ab	58.11 ± 0.005 b	84.06 ± 0.12 c	45.06 ± 0.12 d	97.70 ± 10.40 abc
C3	85.21 ± 0.006 ab	59.24 ± 0.005 f	85.06 ± 0.12 d	47.00 ± 0.06 b	99.07 ± 3.08 c
LSD Value	21.35 *	0.662 *	2.396 *	2.33 *	27.12 *

Note: Means with different letters within the same row are significantly different.($P \leq 0.05$.(

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Estimation of Vitamins in Laboratory-Made Biscuit Treatments

In Table No. (6), a significant statistical increase ($P \leq 0.05$) was observed in the content of vitamins (A, K, E, D, C) in the laboratory-made biscuits with different additions of reishi and lion's mane mushrooms. In the reishi mushroom treatment, there was a gradual increase in vitamin A, reaching 14.22 µg/gm in treatment A3 and 14.87 µg/gm in treatment C3, compared to the control treatment which had 13.21 µg/gm. Additionally, vitamin K increased, reaching 12.01 µg/gm in A3 and 14.55 µg/gm in C3, compared to the control treatment, which had 10.66 µg/gm. There was also a significant increase in vitamin E, reaching 14.43 µg/gm in treatment A3 and 14.33 µg/gm in C3, compared to the control treatment, which had 12.71 µg/gm. The increase in vitamin D also showed a gradual increase, with treatment A3 having the highest value of 12.11 µg/gm and treatment B3 reaching 14.41 µg/gm, compared to the control treatment which was 11.21 µg/gm. Lastly, vitamin C also showed an increase in all biscuit treatments, with the highest values in treatments A3 and C3, reaching 12.87 µg/gm and 11.43 µg/gm, respectively. From the above, it is clear that both mushrooms contributed significantly to increasing the vitamin content in the biscuits, with high statistical significance, thus enhancing the nutritional value of the laboratory-made biscuits

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Table 6. Estimation of Vitamins in Laboratory-Made Biscuit Treatments (µg/gm.(

Sample Code	V.C	V.D	V.E	V.K	V.A
Y	10.71 ± 0.005 d	11.21 ± 0.005 c	12.71 ± 0.006 a	10.66 ± 0.005 f	13.21 ± 0.005 c
A1	11.55 ± 0.005 a	11.22 ± 0.005 e	13.65 ± 0.003 g	11.22 ± 0.005 e	13.40 ± 0.03 b
A2	12.22 ± 0.005 f	11.44 ± 0.005 g	14.33 ± 0.008 c	11.23 ± 0.005 g	13.44 ± 0.006 e
A3	12.87 ± 0.003 g	12.11 ± 0.005 f	14.43 ± 0.003 b	12.01 ± 0.005 d	14.22 ± 0.005 a
C1	10.88 ± 0.005 c	12.33 ± 0.005 b	12.99 ± 0.008 f	13.63 ± 0.003 b	14.12 ± 0.005 d
C2	11.02 ± 0.005 b	14.11 ± 0.005 a	13.99 ± 0.006 d	14.31 ± 0.005 a	14.41 ± 0.008 e
C3	11.43 ± 0.003 e	14.41 ± 0.003 d	14.33 ± 0.003 e	14.55 ± 0.005 c	14.87 ± 0.003 f
LSD Value	0.0158 *	: 0.0167 *	: 0.0195 *	: 0.0167 *	0.0437 *

The means that carry different letters within the same row differ significantly.($P \leq 0.05$.(

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Effect of Treatments on Physical Properties of Laboratory-Made Biscuit

The results presented in Table 7 show slight significant differences in the physical properties of the laboratory-made biscuits. For the height attribute, there was a significant difference between the treatments with the reishi mushroom, with the highest height observed in treatment A1 (29.70 cm), while the height in the C treatments was similar to that of the control treatment (28.40 cm.(

For the width attribute, there was a close similarity across all treatments, with the closest measurements observed in treatments A3 and C3 (5.00, 5.00 cm), compared to the control treatment which was 5.40 cm. Similarly, for the spread attribute, the values showed close variations, with the control treatment being 5.20 cm.

From these observations, it is evident that no major changes occurred in the physical properties of the biscuits despite varying the addition levels of both mushroom types. This suggests that both types of mushrooms can be added to the product without significantly altering its shape and appearance.

Table 7. Effect of Treatments on Physical Properties of Laboratory-Made Biscuit.

Sample Code	Spread Ratio (Mean ± SE)	Width (cm, Mean ± SE)	Height (cm, Mean ± SE)
Y	5.20 ± 0.05 e	5.40 ± 0.06 b	28.40 ± 0.06 c
A1	6.10 ± 0.05 b	4.80 ± 0.05 d	29.70 ± 0.06 b
A2	6.70 ± 0.06 a	4.00 ± 0.05 f	27.00 ± 0.06 d
A3	5.76 ± 0.03 c	5.00 ± 0.06 d	29.00 ± 0.06 a
C1	6.00 ± 0.06 b	4.50 ± 0.05 c	27.00 ± 0.06 d
C2	5.70 ± 0.05 f	5.70 ± 0.06 e	27.00 ± 0.06 d
C3	5.40 ± 0.06 d	5.00 ± 0.06 a	27.10 ± 0.06 d
LSD Value:	0.166	0.175	0.175

Means followed by different letters within the same row differ significantly (P≤0.05 .(

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Sensory Evaluation of Laboratory-Produced Biscuit Treatments

Table (8) shows the sensory evaluation results of laboratory-produced biscuit treatments with varying additions of the two mushrooms. Several sensory attributes were assessed:

- Appearance: Treatments with Lion's Mane mushroom outperformed those with Reishi mushroom. The highest score was observed in treatment (C2) (6.00), close to the control (6.40). The lowest value was recorded for treatment (A2) (2.80), possibly due to the dark color imparted by the increased addition of Reishi mushroom.

- Texture: Significant differences ($P \leq 0.05$) were noted, with Lion's Mane treatments (C1 and C3) achieving the best scores (5.50), compared to the control (6.10.(

- Softness: Reishi mushroom treatments had lower softness values compared to the control and Lion's Mane treatments, decreasing with increased addition levels. The lowest score was found in treatment (A3) (3.36), compared to the control (6.20), while treatment (C3) reached

,(5.60)likely due to the higher fiber content of Reishi mushrooms.

- Flavor: Lion's Mane mushroom treatments surpassed Reishi treatments, with the highest score in (C2) (5.20), compared to the control (5.80.(

- Crispiness: All treatments showed lower crispiness scores than the control (6.10), with the highest among treatments being (C1 and C2) (5.20.(

- Color: Reishi treatments had lower color values with increased additions, while Lion's Mane treatments were closer to the control, with (C1) scoring (5.80) compared to the control (6.50.(

- Overall Acceptance: Lion's Mane treatments had significantly higher overall acceptance, with the highest score in treatment (C1) (5.70), compared to the control (6.20.(

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Table 8. Sensory Evaluation of Laboratory-Made Biscuit Treatments.

Mean ± Standard Error							
Sample Code	Overall Acceptance	Color	Flakiness	Flavor	Softness	Texture	Appearance
Y	6.20 ± 0.06 a	6.50 ± 0.06 a	6.10 ± 0.05 a	5.80 ± 0.06 a	6.20 ± 0.05 a	6.10 ± 0.06 a	6.40 ± 0.06 a
A1	4.10 ± 0.06 d	4.40 ± 0.06 c	4.30 ± 0.05 d	3.86 ± 0.03 e	3.76 ± 0.03 f	4.10 ± 0.06 c	4.50 ± 0.06 d
A2	3.70 ± 0.06 e	3.00 ± 0.06 d	4.20 ± 0.06 d	4.40 ± 0.05 d	4.30 ± 0.05 e	3.90 ± 0.06 d	3.50 ± 0.06 e
A3	2.90 ± 0.06 f	2.80 ± 0.06 e	3.50 ± 0.06 e	3.40 ± 0.06 f	3.36 ± 0.03 g	2.80 ± 0.05 e	2.80 ± 0.05 f
C1	5.70 ± 0.06 b	5.80 ± 0.06 b	5.20 ± 0.06 b	5.00 ± 0.06 c	5.30 ± 0.06 c	5.50 ± 0.06 b	5.70 ± 0.06 c
C2	5.60 ± 0.06 b	5.70 ± 0.06 b	5.20 ± 0.06 b	5.20 ± 0.06 b	5.10 ± 0.06 d	5.40 ± 0.05 b	6.00 ± 0.05 b
C3	5.30 ± 0.06 c	5.70 ± 0.06 b	4.70 ± 0.06 c	4.90 ± 0.05 c	5.60 ± 0.05 b	5.50 ± 0.06 b	5.70 ± 0.06 c
LSD Value	0.175 *	0.175 *	0.175 *	0.167 *	0.158 *	0.175 *	0.175 *

Means with different letters within the same row differ significantly.($P \leq 0.05$.(

Conclusion Lion's Mane mushroom treatments showed superior sensory properties compared to Reishi treatments across all attributes. The bitter taste and darker color of Reishi mushroom negatively impacted sensory evaluation, despite its nutritional benefits. High fiber and mineral content in Reishi mushrooms reduced softness and crispiness. These processes and additions are essential for improving product quality [6]. Therefore, it is recommended to use it in daily products to enhance their nutritional value.

Conclusions

It is clear from the previous analysis that both types of mushrooms (Lion's Mane and Reishi) have high nutritional value, rich in minerals, vitamins, fibers, proteins, and carbohydrates, all of which offer significant benefits in the treatment of many diseases. This has enhanced the value of the product made from lentils and oats, allowing for the potential use of both mushrooms in food products. However, due to the dark color and bitter taste of the Reishi mushroom, the Lion's Mane mushroom product excelled and achieved higher nutritional values. This issue can be addressed by exploring the possibility of pairing Reishi mushrooms with other ingredients that reduce their bitterness and improve overall acceptance. Additionally, Lion's Mane mushrooms can be effectively used in grilled and cooked products, as well as in the production of foods beneficial for patients with diabetes and digestive disorders.

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