



THE EFFECT OF MUSHROOM (*AGARICUS BISPORUS*) POWDER ON THE SENSORY PROPERTIES OF SOFT CHEESE AND PROLONGING ITS SHELF LIFE.

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Received 26/ 6/ 2024, Accepted 16/ 9/ 2024, Published 30/ 9/ 2026

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ABSTRACT

The current study aimed to study the impact of adding various concentrations of *Agaricus bisporus* mushroom to soft cheese maintaining and improving nutritional and sensory characteristics for more than 14 days of storage. The mushroom powder was added to soft cheese treatment as: (T 2, T 3, T4, T5 and T1 at 0.7%, 0.9 %, 1.1 %, 1.3 % and control treatment respectively). The chemical composition of soft cheese was estimated during storage periods For (0, 3, 6, 9, 12, 15) days of storage. The results showed that the highest concentration of the mushroom powder added to soft cheese had the lowest content of protein, fat, and ash, as 23.78, 5.00, and 26.34 on zero time, respectively. The nutritional value was maintained via the different concentrations when added to the soft cheese after 14 days of storage period. The results showed the highest concentration of mushroom powder in soft cheese had high content of ash, fat, and protein such as 4.7, 26.2, and 23.0, respectively, but it was contained the lowest moisture content around 43.02%. In general, the T 1 treatment showed the highest values of the sensory evaluation in flavour, general acceptance, consistency of texture, and general acceptance, was 99.1 degrees of total score , but sample did not evaluation after 9 days due to spoilage, while the T 5 treatment showed the highest concentration of mushroom powder was 92.7 degrees of total score on the 15th day of Storage.

Keywords: White soft cheese, sensory evaluation, *Agaricus bisporus* , Storage.

تأثير مسحوق فطر الاكاركس على الصفات الحسية للجبن الطري وإطالة مدة خزنه

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الخلاصة:

هدفت الدراسة الحالية إلى دراسة تأثير إضافة تراكيز مختلفة من فطر الاكاركس إلى الجبن الطري الناعم لغرض الحفاظ على القيمة الغذائية وتحسين الخصائص الحسية خلال خزنه لمدة تصل إلى 14 يوم حيث أضيف مسحوق فطر الاكاركس إلى الجبن بأربع تراكيز هي (T 2 = 0.7 %، T 3 = 0.9 %، T 4 = 1.1 %، T 5 = 1.3 %) بالإضافة إلى معاملة السيطرة T 1 قدر التركيب الكيميائي للجبن الطري خلال فترات خزن (0، 3، 6، 9، 12، 15) يوم اظهرت النتائج أن أعلى تركيز من فطر الاكاركس المضاف إلى الجبن الأبيض قد اعطت اقل محتوى من البروتين والدهن والرماد اذ بلغت في وقت الصفر (23.78، 5.00، 26.34) على التوالي ولقد حافظت على القيمة الغذائية التراكيز المختلفة من الفطر المضاف الى الجبن الابيض الطري خلال فترة الخزن حيث تم قياسه بعد 14 يوم من الخزن واظهرت النتائج من هذه الاختبارات بأن أعلى تركيز من مسحوق الفطر في الجبن الأبيض الطري اعطى أعلى محتوى من الرمد الدهن البروتين اذ بلغت (4.7، 26.2، 23.0) % على التوالي ولكنها احتوت على اقل نسبة من الرطوبة اذ بلغت 43.02 %، ولقد أظهرت المعاملة T 1 أعلى قيم في التقويم الحسي للنكهة والتقبل العام وتماسك القوام اذ بلغ مجموع النقاط 99.1 درجة ولكن بعد مرور 9 أيام لم تحصل العينة على تقييم بسبب تلفها في حين ان أعلى تركيز من المسحوق T 5 بلغ مجموع نقاطه 92.3 درجة في اليوم الـ 15 من الخزن.

الكلمات المفتاحية: الجبن الأبيض الطري، التقويم الحسي، فطر الاكاركس ، التخزين.



INTRODUCTION

Cheese is a solid or semi-solid product that is made by coagulating milk using rennet or other suitable coagulating agents, acidification, or a combination of both methods. The curdling of milk is the fundamental process in the production of all varieties of cheeses (**Zheng *et al.*, 2021**). soft cheese is a food product derived from animal milk and played a significant role as dairy product in human nutrition for many centuries. The white soft cheese is predominant varieties of cheese that are abundantly available in the Iraqi markets (**Górska-Warsewicz *et al.*, 2019**). Cheeses are highly susceptible to contamination with pathogenic and spoilage microorganism such as *Listeria monocytogenes*, *Staphylococcus aureus* and *Salmonella* spp. and frequently associated with outbreaks of foodborne illness due to cheese consumption resulting in reduced shelf life those poses a health risk to consumers (**HASSANIEN *et al.*, 2014**). In the last years, the consumers requested safe and health food was increased as well as without synthetic preservatives due to their harmful and cancer-causing substances (**MORO *et al.*, 2015**). The food industry and research institutions are seeking natural preservatives as substitutes for synthetic ones to meet consumer demands and enhance market competitiveness by differentiating their products. Aromatic and medicinal plants are currently employed in pharmaceutical industries for their bioactive compounds and in food industries as flavor enhancers. In recent times, the potential antimicrobial effect of these substances has garnered heightened attention from food scientists and technologists (**COSTA *et al.*, 2013**). Presently, there is a growing consumer demand for functional products that aid in mitigating the likelihood of diseases. Consequently, there is an expanding market for food products that incorporate probiotic bacteria. The annual sales growth of these products ranges from 7% to 32%, depending on the specific products and geographical regions (**Alinovi *et al.*, 2020**). Lately, consumers have shown an increasing preference for prioritizing their personal health, resulting in a demand for food that is not only nutritious but also has the ability to prevent illness. Multiple documents aim to clarify the improvement of white cheese quality by using different additives, including lemon and grapefruit, cinnamon and thyme, cranberry fruit powder, lupin milk, soy protein and Mushroom. The mushroom type of *Agaricus bisporus*, also known as White Mushroom, is one of the most commonly grown and consumed mushroom species globally due to its appealing taste, aroma, and nutritional properties. This type of mushroom is a valuable source of fiber, essential and nonessential amino acids, unsaturated fatty acids (linoleic acid, linolenic acid, and palmitic acid), antioxidant activity substances such as sterols, ergothioneine, indole, and phenolic compounds such as selenium, vitamins and zinc. (**Krakowska *et al.*, 2016**, **Ndungutse *et al.*, 2015**).

The significance of *A. bisporus* in promoting health stems from its confirmed ability to prevent and treat breast and prostate cancer, as demonstrated by its anticancer properties (**Novaes *et al.*, 2011**). The anticancer properties of *A. bisporus* fruiting bodies can be attributed to the presence of tyrosinase and polysaccharides (**Krakowska *et al.*, 2016**). The metal cations found in *A. bisporus* mycelium are essential components of several enzymes, serving as activators for these enzymes. The fruiting bodies of *A. bisporus* contain substantial quantities of the following essential elements: zinc, magnesium, phosphorus, calcium, and manganese, potassium, copper, sulfur selenium, and sodium. (**Falandysz & Drewnowska, 2015**) The mushroom health benefits and its organic nutrients content led it a valuable addition to one's



diet, especially for deficiencies in macro- and micronutrients individuals with diagnosed. Thus, it is challenging to acquire research material that accurately represents the characteristic of the subject in its natural environment. The high tolerance of mushroom to presence the heavy metals due to its unique capability to destroy reactive oxygen radicals, which function as the natural defensive mechanisms of mycelium (Haro *et al.*, 2020). The main objective has consistently been and continues to be the conversion of milk into a product that can be stored for a longer time, while preserving most of its vital nutrients

MATERIALS AND METHODS

sample Collection

The fruit body of *A. bisporus* mushrooms was collected with both white and brown breeds A 15 Sylavan from the Al-wadaq mushrooms farm place in Baghdad, when the fruit bodies were washed with distilled water, and then the fruit bodies were cut into small slices.

Proximate analysis

The analysis of protein content for powdered samples has been concluded using the **Kjeldahl method**. The Kjeldahl process was initiated by wrapping 0.5 g of each powdered sample in a single sheet of glassine weigh paper. This was then combined with 10 mL of sulfuric acid and one Fisher TabST-AUTO Kjeldahl tablet, which contains potassium sulfate and selenium to expedite digestion. The mixture was digested using setting four on the Labconco digestion block for a duration of 10 min, followed by the 7.5 heat setting for a period of 3 h. The transparent and cooled mixture was subjected to distillation for a duration of 10 min using the Labconco RapidStill II apparatus (Kansas City, MO, USA). The receiving solution, consisting of 25 mL, comprised of 4% boric acid (pre-adjusted to a pH of 4.65 using 0.1 N sodium hydroxide) and four drops of bromocresol green-methyl red indicator. Additionally, 30 mL of 50% sodium hydroxide was introduced into the mixture just before the distillation process. The amount of 0.1 N standardized hydrochloric acid needed to adjust the pH of the receiving solutions back to 4.65 was used to estimate the protein content. The identical technique was employed to determine the protein content in the eight supernatants and pellets that were dried in a forced draft oven at a temperature of 90 °C. The conversion factor utilized was 6.25 for soy protein and 4.38 for all mushroom samples.

The moisture content of the six powdered was measured using a forced draft oven (Stabil-Therm gravity oven, Blue Island, IL, USA) set at 100 °C. The measurement was done gravimetrically. A minimum of 0.9 grams of each sample was subjected to heating in the oven. The samples were placed in partially covered aluminum dishes and heated for a duration of 3 h. After heating, the weights of the samples were measured for 30 min intervals until the weight loss between intervals did not exceed 0.002 grams. The samples were allowed to cool in a desiccator for a 30 min prior to recording their weights.

In order to determine the ash content, the four powdered samples were placed inside a muffle furnace (Thermolyne, Muffle Furnace 1200°C Maximum BR-12N, Furnace) that was set to a temperature of 525 °C for a duration of 12 h. The temperature rose steadily at a rate of 190 °C per hour until it reached the desired temperature of 525 °C. Once the furnace reached a temperature of 100–110 °C, the samples were transferred to a desiccator and allowed to cool



for at least 30 min before being weighed. The identical technique was employed to assess the ash content in both the supernatants and pellets of the eight forced draft oven-dried samples at a temperature of 90 °C. The determination of fiber content was carried out using a commercially available Total Dietary Fiber kit (Aldrich Total Dietary Fiber Assay Kit). The fiber analysis was conducted four times according to the instructions provided with the kit. This involved duplicating the ash measurement and duplicating the adjustment of protein in the quantified fiber residue. The procedures for ash and protein analysis were thoroughly described in this section of the manuscript. The identical technique was employed to determine the fiber content in the eight supernatants and pellets that were dried in a forced draft oven at a temperature of 90 °C.

extraction of phenol compounds

Phenol compounds were recovered from the dried powder by adding 100 ml of chloroform to 20 grams of plant powder after well grinding, placed on electric vibration for 3 h to remove the fat from the sample, then removed the chloroform layer. After drying the sample at 50°C to ensure that there were no traces of chloroform, 10 g of the dried sample was taken for extraction using ethanol/water solvent (70/30). The extraction was done using the ultrasound bathroom (United States of America) at room temperature for one hour. After the nomination, 5 ml of liquid extract was used to determine extraction productivity. After the solvent was removed by the rotor evaporation in the middle of an empty air (Slovenia), it was dried at 40°C until reaching the fixed mass after which dry extracts were stored in glass packaging at 4°C to prevent oxidation damage until analysis. The quantification of individual PVs was done through HPLC reverse-phase analysis, measuring 0.25 cm and 4.6 mm. The temperature of the column was 30 degrees Celsius, and the phased rinse method was performed, using A (methanol (1% and B-formic acid in water) as follows: 0-4 min, 40% B; 4-10 min, 50% B. At 0.7 m/minute flow rate. The sample size of the injected samples was 100 microliters and 100 micro older standards were automatically done using the automatic sampling device. The spectrometer was obtained at 280 nm.

The results showed that white mushroom powder contains more efficient compounds than brown mushroom powder, so we completed this study by selecting white mushroom powder and introducing it into food applications as an antioxidant by merging it with soft cheese and then studying its inhibitive effectiveness.

The milk sources.

(Table 1) shows the percentages of milk components and the PH of milk used in the soft cheese industry, which are within the acceptable limits of the raw milk used in the soft cheese industry, which was processed in the dairy Laboratory, in the Faculty of Agricultural Engineering Sciences, Baghdad University.



Table (1): milk components and the PH of milk used in the soft cheese industry.

Components	% Milk
humidity %	88.35
Acid (Lactic acid) %	0.16
Fat %	3.14
Protein %	3.04
Non-fat solids %	8.47
Total solids %	11.78
Qualitative weight	1.032
pH	6.3

Manufacture of cheese

According to the method described by **Chandan *et al.* (2015)**, where crude beef milk was received full fat (10 kg), the slow blazer operation was performed at a temperature of 63 °C for 30 min, after which milk was returned to 42 °C and the microbial Meito Rennet was added, processed by the Japanese-born Meito Sangyo (1 mg/100 kg milk) after melting with distilled water and leaving milk for 30 min until clotting, and was cut long and accidentally, left for 5 min without movement, then shripped, added salt at 2% of the wit weight, collected and divided into 5 coefficients: T1 was used as a control treatment (without adding *Agaricus bisporus* Powder) and with a weight of 0.7%, 0.9% , 1.1% and 1.3% of *Agaricus bisporus* Powder T2, T3 , T4 and T5 transactions, respectively.

Chemical analysis of soft cheese.

Estimation of pH

The pH of cheese is estimated according to the method cited by **Ling (2008)**, with 3 g of cheese and a good mix with 10 ml of distilled water in a ceramic mortar and pH-meter.

Estimation of total acidity ratio

The rate of acidity according to the method described by A.O.A.C (2010) was estimated at 3 g of cheese and was well mixed with 10 ml of distilled water in a ceramic mortar and then retrofitted with sodium hydroxide solution NaOH with the phenolphthalene detector. The percentage of total acid was calculated on the basis of lactic acid according to the following equation:

$$\text{Total acidity} = \frac{\text{Number of Naoh milliliters consumed} \times 0.009 \times 0.1}{\text{Sample weight (g)}}$$



Estimation of humidity ratio

The percentage of moisture was estimated according to the method described by A.O.A.C (2010) using sterile and clean drying cabins, weighed empty, then taken 3 g of cheese and placed in the oven at 105 m for 3 h, then weighed after cooling and estimated the percentage humidity according to the following equation:

$$\% \text{ humidity} = \frac{\left(\frac{\text{the weight of the sample with}}{\text{the eyelids before drying}} \right) - \left(\frac{\text{the weight of the sample with}}{\text{the eyelids after drying}} \right)}{\text{Sample weight}(g)}$$

Estimation of protein ratio

The protein ratio in the cheese was estimated using the microcooldale method according to Joslyn, (1970).

Estimation of fat ratio

The babcock-style fat ratio was estimated to be 4.5 g of cheese and to be using the Bopcock bottles listed from zero to 40 (Ling, 2008).

Estimation of ash ratio

The cheese models were Drying in Muffle Frunace at 550° C temperature according to the method described by A.O.A.C (2010) and the percentage of ash was estimated by the following equation:

$$\% \text{ Ash} = \frac{(\text{wheel whirring with ash} - \text{wheel whirring empty})}{\text{Sample weight}(g)} \times 100$$

Estimation of dissolved nitrogen

In accordance with the method cited by **Ling (1963)**, melted nitrogen was estimated to take 5 g of cheese chopped, add 100 ml of distilled water, mix with electricity for 2 min, and transport quantitatively to 250 ml and complete size to mark, filter the solution using filter paper (Whatman No. 42) Ten ml of leachate was transferred to the digestor bottle for the microckeldal device, to which 10 ml of sulfuric acid was added H₂SO₄ with the addition of digestor powder consisting of selenium oxide, blue copper sulfate and potassium sulfate at 1.2-25%) and the digestion and distillation process was completed according to the method described **Joslyn, (1970)**.

Estimation of fatty acidity

The ADV (Acid Degree Value) cited by **Deeth & Fitz-Gerald (1983)** was estimated at 5 g of cheese soluble in 37.5 ml of sodium jacket solution at 50 m temperature and 10 ml of Bureau of Dairy Industry (BDI), consisting of 30 g of Triton x-100 with 70 g of Sodium hexameta phosphate), then boiling temperature heating for 2 min with continuous motion, then a centralized package of 45,000 g for 1 minute, and a sufficient quantity of 50% water methyl alcohol solution was added, and then a centralized package for 1 minute. He then took a certain weight of deduced fat and was placed in a 100-ml cerebral circus with an additional 5 millimeter of mixture (1:4) hexan: propanol and then mired against a 0.02 caliber solution of potassium alcohol with the alcohol phenaphthalene evidence and then according to the ADV from the following equation:



$$\% ADV = \frac{mL\ KOH\ for\ sample - mL\ KOH\ for\ blank}{Weight\ of\ Fat} \times N \times 100$$

Sensory evaluation

The sensory evaluation of the cheese samples was carried out by 16 Evaluators of the Department of Food Sciences, University of Baghdad, and used cheese sensory calendar form Al-Dahhan's (1977). The upper limits of flavour 45 and of texture 35 and the colour and appearance of each of them are set at 10.

Statistical analysis

The Statistical Analysis System (SAS) was utilized in the data analysis to examine the influence of various transactions on the analyzed attributes. A complete random design (CRD) was employed, and the moral disparities between averages were compared to identify the smallest moral difference. The term "Least Significant Difference" is sometimes abbreviated as "LSD."

RESULT AND DISCUSSION

The moisture content.

The data in Table Table() shows that the moisture content of soft white cheese increased as the pickling times at refrigerator temperatures increased, up to 14 days. The treatment containing the *Agaricus bisporus* Powder, which was stored for 14 days, exhibited lower moisture levels compared to the control treatments. The rise in moisture content in control sample can be attributed to the refrigerator temperature, which facilitates the absorption of whey into the curd. Kebary *et al* (2015) also observed similar findings.

Content of proteins

The protein content of soft white cheese showed a statistically significant decline ($P < 0.05$) in T1, T2 T3 and less in T4, T5 in 14 days. The level of soft white cheese protein is decreasing as the moisture content increases during the pumping process. The protein composition of the cheese samples was consistent with the findings of Davla *et al.* (2021), El-Sayed & El-Sayed (2021).

Content of fat

The fat content of the observation and treatment groups was not significantly affected in the first seven days of storage but after the second week and on the 14th day of storage, the control sample showed a marked decrease in the fat ratio and fell from 25.4 to 19.8 while the transaction of T1, T2, T3, T4 fell to 25.1, 25.8, 26,26.2 respectively, the transactions maintained the fat content of the powder (Patinho *et al.*, 2021). Moreover, Govares *et al.* (2011) reported that the use of extract did not affect the fat ratio in cheese during the storage period.



Table(2) chemical composition for Zero-time and after 14 days of soft cheese.

	chemical composition results in Zero-time for soft cheese.					Chemical composition results after 14 days of soft cheese.				
Treatment*	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
Protein %	23	23.41	23.56	23.66	23.78	18.9	21	22.1	22.7	23
Lipid %	25.4	26	26.12	26.22	26.34	19.8	25.1	25.8	26	26.2
Ash %	4.6	4.8	4.88	4.95	5	2.9	3.9	4.2	4.5	4.7
Moister %	44.5	43.11	43	42.89	42.7	52.6	44.1	43.8	43.2	43
CHO %	2.5	2.68	2.44	2.28	2.18	5.8	5.9	4.1	3.6	3.1

* Each value in the table was the mean of three replicates.

* T1: negative control, soft white cheese without any additives. T2, T3, T4 and T5: soft white cheese treatments made by adding 0.7, 0.9, 1.1 and 1.3% powder of *Agaricus bisporus* respectively.

PH:

The results of the pH estimate shown in(figure 1) showed that the pH value was in zero time (immediately after manufacture) for all treatment , but during the cold storage of the cheese, a decrease was observed between 5.59-5.88 in the pH values in the transactions, while the pH figure for T1 treatment) was significantly reduced to 5.32 during the storage period of 14 days as a result of metabolic metabolisms of the cheese microorganisms leading to the consumption of the remaining lactose sugar in the cheese and its conversion to lactic acid and other organic acids, leading to an increase in acidity and a decrease in the pH value of the cheese, which is consistent with **Chirsanova et al. (2021)** .

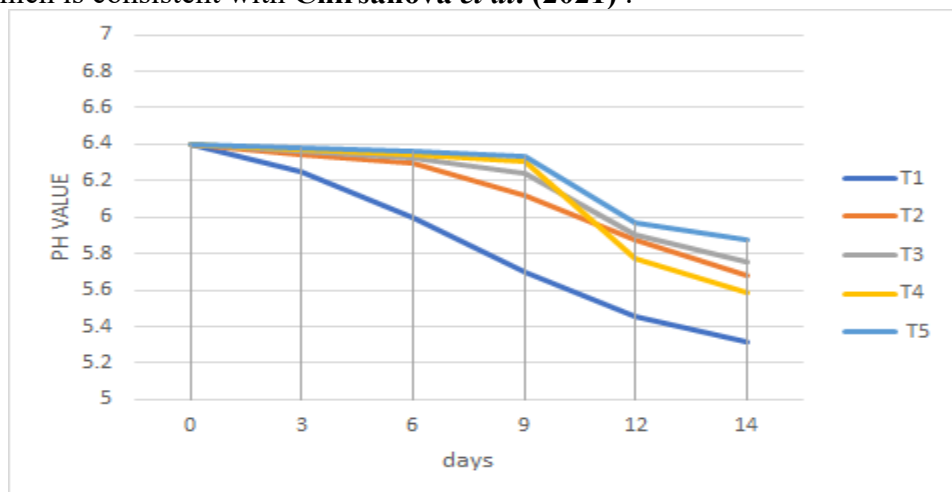


Figure (1): pH values of soft white cheese treatments and control during storage at 14 ± 1°C.

Acidity ratio

The acid shared a balance with other compounds to give taste and flavor of cheese and then to influence consumer acceptance of cheese (**Fox & Wallace, 1997**). (Figure 2) shows the percentage of acidification during the 14-day storage period, with acid values in cheese made



(T1) rising from 0.16 to 0.46% and in cheese manufactured (T2) from 0.16 to 0.37% after 14 days of storage and in cheese supplied (T3), rising from 0.16 to 0.33% and in cheese produced from 0.16 to 0.30%, and in cheese produced (T5) from 0.16 to 0.28%. The results of the statistical analysis showed a moral difference ($P>0.05$) in the values of acidity at 0 and 14 days of age between the processes of cheese manufactured in accordance by **Tang et al. (2017)** (**Difonzo et al. 2023**).

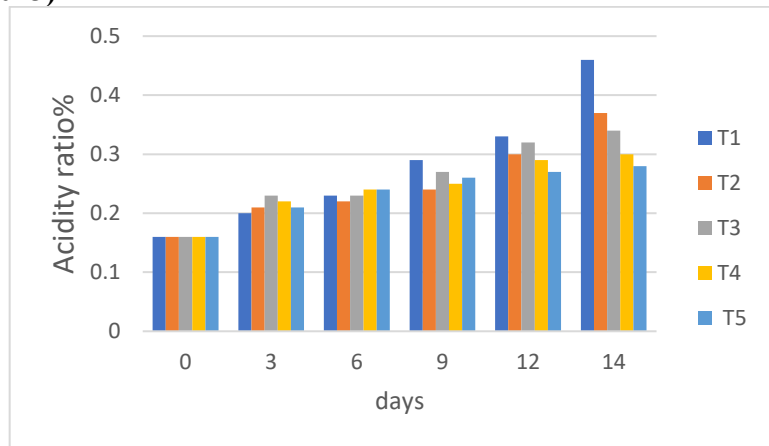


Figure (2): Acidity ratio of soft white cheese treatments and control during storage at 14 ± 1°C.

Sensory evolution

The results (table 3) show sensory cheese characteristics such as flavour, strength, appearance and colour, and indicate that the sensory properties of the cheese added to the fungus powder in the first six days of storage were not significantly affected except for the color quality, which was lower than the control sample due to the work of the powder molecules that reduced the colour (**Tariq Khal & Ali Mosa, 2018**). The table shows that there were no significant differences in all samples in the first six days, but after the first week had passed, the control sample began to decline, and on the ninth day it was not evaluated due to spoilage, but the samples to which the powder was added recorded sensory acceptable values, especially T5 with a concentration of 1.3%, where it obtained a degree of 92.7 in sensory evaluation, and this result is consistent with what was stated **Hussein et al., (2020)**.

Table (3):Sensory properties of processed cheese added to Agaricus bisporus mushroom powder during storage periods.

Age of storage	Treatment*	Taste and flavor. 45%	Strength and tissue 35%	color. 10%	Appearance 10%	Final degree 100%
Zero time	Control T1	44.7	35	10	10	99.1
	0.7 % T2	42.6	34.2	9.3	9.8	95.9
	0.9 % T3	44.6	32.6	9.1	9	95.3
	1.1 % T4	43.3	33.3	9.3	8.9	94.9
	1.3 % T5	43.5	34.3	9	8.6	95.4



After 3 days	Control T1	43.75	34	10	10	97.75
	0.7 % T2	41.5	33.25	9.7	9.2	93.75
	0.9 % T3	42.5	33.8	9.5	8.5	94.3
	1.1 % T4	41.75	33.7	8.5	8.9	92.9
	1.3 % T5	42.5	31.75	8.2	8.7	95.5
After 6 days	Control T1	39.5	29.6	9.2	8.5	86.5
	0.7 % T2	42.5	32.2	9.1	8.2	92.1
	0.9 % T3	41.3	33.9	8.3	8.3	93.6
	1.1 % T4	43.4	32.1	8.6	8	94.9
	1.3 % T5	42.2	33	8.2	8.4	93.8
After 9 days	Control T1	—	—	—	—	—
	0.7 % T2	40.6	30.5	9	8	90.9
	0.9 % T3	41.6	32.2	8.3	8.4	91.5
	1.1 % T4	40.7	31.9	7.9	8.1	90.1
	1.3 % T5	43.5	33.4	8	8.8	93.9
After 12 days	Control T1	—	—	—	—	—
	0.7 % T2	39.6	32	9.1	8.9	89.7
	0.9 % T3	38.3	30.1	8.7	8.2	87.3
	1.1 % T4	42.3	32.1	7.8	8.3	90.5
	1.3 % T5	41.6	33	7.9	8	93
After 15 days	Control T1	—	—	—	—	—
	0.7 % T2	38	29.2	8.5	8.4	84.8
	0.9 % T3	36.9	30.3	8.4	9.2	86.4
	1.1 % T4	40.4	31.2	8.2	9.4	89.5
	1.3 % T5	42.7	32.7	7.8	8.8	92.7

*See Table 2

CONCLUSIONS

Application of *Agaricus bisporus* powder can extend the shelf life of soft cheese. Cheese enriched with powders from *Agaricus bisporus* has been identified based on its sensory qualities. *Agaricus bisporus* powder has been used to enhance the acceptability of soft cheese during storage. The mushroom powder as *Agaricus bisporus* could be applicable in dairy field is potentially significant. As it possesses high nutritional value due to its maintainance ability of the protein and fat proportions throughout storage and could be readily marketed due to it has acceptable of flavor level.

REFERENCES

1. Al-Dahhan, A. H. (1977). *A study of the visible characteristics of cheese*. Theses.gla.ac.uk. <https://theses.gla.ac.uk/72277/>
2. Alinovi, M., Mucchetti, G., Wiking, L., & Corredig, M. (2020). Freezing as a solution to preserve the quality of dairy products: the case of milk, curds and cheese. *Critical Reviews in Food Science and Nutrition*, 1–21.
3. Chandan, R. C. (2015). Dairy Processing and Quality Assurance: An Overview. *Dairy Processing and Quality Assurance*, 1–40.



4. Costa, D. C., Costa, H. S., Albuquerque, T. G., Ramos, F., Castilho, M. C., & Sanches-Silva, A. (2015). Advances in phenolic compounds analysis of aromatic plants and their potential applications. *Trends in Food Science & Technology*, 45(2), 336–354.
5. Costa, J. C., Claro, R. M., Martins, A. P. B., & Levy, R. B. (2013). Food purchasing sites. Repercussions for healthy eating. *Appetite*, 70, 99–103.
6. Dafalla, Al., Razig, K. A. A., & Elrofaei, N. A. (2021). Effect of Types of Probiotic Bacteria on Physiochemical Properties of Sudanese White Soft Cheese. *American Scientific Research Journal for Engineering, Technology, and Sciences*, 78(1), 83–97. https://asrjetsjournal.org/index.php/American_Scientific_Journal/article/view/6756
7. Deeth H.C., Fitz-Gerald C.H., Lipolytic enzymes and hydrolytic rancidity in milk and milk products, in: Fox P.F. (Ed.), *Developments in Dairy Chemistry*, Vol. 2, Chapman and Hall, London, UK, 1983, pp. 195-240.
8. Difonzo, G., Antonino, C., Squeo, G., Caponio, F., & Faccia, M. (2023). Application of Agri-Food By-Products in Cheesemaking. *Antioxidants*, 12(3), 660–660. <https://doi.org/10.3390/antiox12030660>
9. Dimitreli, G., Stylianos Exarhopoulos, Antoniou, K. K., Zotos, A., & Bampidis, V. A. (2017). Physicochemical, textural and sensory properties of white soft cheese made from buffalo and cow milk mixtures. *International Journal of Dairy Technology*, 70(4), 506–513.
10. El-Sayed, H. S., & El-Sayed, S. M. (2021). A modern trend to preserve white soft cheese using nano-emulsified solutions containing cumin essential oil. *Environmental Nanotechnology, Monitoring & Management*, 16, 100499.
11. Falandysz, J., & Drewnowska, M. (2015). Macro and trace elements in Common Chanterelle (*Cantharellus cibarius*) mushroom from the European background areas in Poland: Composition, accumulation, dietary exposure and data review for species. *Journal of Environmental Science and Health, Part B*, 50(5), 374–387.
12. Górska-Warsewicz, H., Rejman, K., Laskowski, W., & Czeczotko, M. (2019). Milk and Dairy Products and Their Nutritional Contribution to the Average Polish Diet. *Nutrients*, 11(8), 1771. <https://doi.org/10.3390/nu11081771>
13. Haro, A., Trescastro, A., Lara, L., Fernández-Fígares, I., Nieto, R., & Seiquer, I. (2020). Mineral elements content of wild growing edible mushrooms from the southeast of Spain. *Journal of Food Composition and Analysis*, 91, 103504.
14. Hassanien, M. M., Mahgoub, S. A., & El-Zahar, K. M. (2014). *Soft cheese supplemented with black cumin oil: Impact on food borne pathogens and quality during storage*. 21(3), 280–288.
15. Hassanien, M. M., Mahgoub, S. A., & El-Zahar, K. M. (2014). *Soft cheese supplemented with black cumin oil: Impact on food borne pathogens and quality during storage*. 21(3), 280–288.



16. He, K., Mao, Q., Zang, X., Zhang, Y., Li, H., & Zhang, D. (2017). Production of a broad-specificity monoclonal antibody and application as a receptor to detection amatoxins in mushroom. *Biologicals*, 49, 57–61.
17. Hussein, Y., Kebary, K., Badawi, R., & Eldhshan, F. (n.d.). ON N I IT TS S Q QU UA AL LI IT TY Y A AN ND D T TH HE E S SU UR RV VI IV VA AL L O OF F B BI IF FI ID DO OB BA AC CT TE ER RI IA A B. Retrieved June 22, 2024, from https://ejds.journals.ekb.eg/article_235555_2189e46e8655b6fc7cddd17d43cd8652.pdf.
18. Joslyn, M.A. (1970). *Methods in food analysis: physical, chemical and instrumental methods of analysis*. New York: Academic Press, 749-754.
19. Kebary, K.M.K.; Hamed, A.I.; Badawi, R.M.; Salem, O.M. and Omar, Nevein, S. (2015). Preparation and properties of low-fat ice milk fortified with inulin. *Egyptian J. Dairy Sci.*, 43: 169.
20. Krakowska, A., Reczyński, W., & Muszyńska, B. (2016). Optimization of the Liquid Culture Medium Composition to Obtain the Mycelium of *Agaricus bisporus* Rich in Essential Minerals. *Biological Trace Element Research*, 173(1), 231–240.
21. Krakowska, A., Reczyński, W., Krakowski, T., Szewczyk, K., Opoka, W., & Muszyńska, B. (2021). A New Biotechnology Method of Bioelements' Accumulation Monitoring in In Vitro Culture of *Agaricus bisporus*. *Molecules*, 26(17), 5165.
22. Ling E.R. (1963) *A Textbook of Dairy Chemistry. (Practical)* third ed. vol. 2. Chapman & Hall, Ltd., London.
23. Moro, A. M., Brucker, N., Charão, M. F., Sauer, E., Freitas, F., Durgante, J., Bubols, G., Campanharo, S., Linden, R., Souza, A. P., Bonorino, C., Moresco, R., Pilger, D., Gioda, A., Farsky, S., Duschl, A., & Garcia, S. C. (2015). Early hematological and immunological alterations in gasoline station attendants exposed to benzene. *Environmental Research*, 137, 349–356.
24. Moro, A., Librán, C. M., Berruga, M. I., Carmona, M., & Zalacain, A. (2014). Dairy matrix effect on the transference of rosemary (*Rosmarinus officinalis*) essential oil compounds during cheese making. *Journal of the Science of Food and Agriculture*, 95(7), 1507–1513.
25. Ndungutse, V., Mereddy, R., & Sultanbawa, Y. (2015). Bioactive Properties of Mushroom (*Agaricus bisporus*) Stipe Extracts. *Journal of Food Processing and Preservation*, 39(6), 2225–2233.
26. Novaes, M. R. C. G., Valadares, F., Reis, M. C., Gonçalves, D. R., & da Cunha Menezes, M. (2011). The effects of dietary supplementation with Agaricales mushrooms and other medicinal fungi on breast cancer: Evidence-based medicine. *Clinics*, 66(12), 2133–2139.
27. OAC (2010) *Official Methods of Analysis of Association of Official Analytical Chemists*. 18th Edition, Washington, DC. - References - Scientific Research Publishing. (n.d.). [Www.scirp.org](http://www.scirp.org). Retrieved June 8, 2024, from



28. Patinho, I., Selani, M. M., Saldaña, E., Bortoluzzi, A. C. T., Rios-Mera, J. D., da Silva, C. M., Kushida, M. M., & Contreras-Castillo, C. J. (2021). *Agaricus bisporus* mushroom as partial fat replacer improves the sensory quality maintaining the instrumental characteristics of beef burger. *Meat Science*, 172, 108307.
29. Tang, W., Dong, M., Wang, W., Han, S., Rui, X., Chen, X., Jiang, M., Zhang, Q., Wu, J., & Li, W. (2017). Structural characterization and antioxidant property of released exopolysaccharides from *Lactobacillus delbrueckii* ssp. *bulgaricus* SRFM-1. *Carbohydrate Polymers*, 173, 654–664.
30. Tariq Khal, N., & Ali Mosa, M. (2018). Effect of Wheat Germ on Chemical, Sensory and Technological Properties of Soft Cheese. *International Journal of Dairy Science*, 13(1), 40–45.
31. Zheng, X., Shi, X., & Wang, B. (2021). A Review on the General Cheese Processing Technology, Flavor Biochemical Pathways and the Influence of Yeasts in Cheese. *Frontiers in Microbiology*, 12, 703284.