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# The Effect of Adding Sun-Dried Oyster Mushrooms on the Nutritional Value and Organoleptic Properties of Chicken Burgers

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**ABSTRACT**:

The main aim of this study was to explore the effect **of** adding sun-dried oyster mushrooms on the nutritional value and organoleptic properties of chicken burgers. Sample (1, 2 and3) were prepared by replacement (10, 20 and 30%) of chicken meat with oyster mushroom powder respectively. Nutritional composition and physiochemical characteristics of samples were measured. The results showed that oyster mushroom was rich in protein and ash content which were (5.07 and 1.57%), respectively, and low fat and fiber content. Sample S1 recorded the highest protein content, while sample S2 recorded the lowest fat and fiber content Sample S3 showed the highest ash, fiber, and carbohydrates contents fat content, while its lowest fat content in organoleptic evaluation S3 recorded the lowest values in shrinkage and cooking loss. It observed that there was inverse relationship a significant between "shrinkage and cooking loss" and between "cooking yield and moisture retention" and this led to rise in its value weight of cooked burger and diameter of cooked burger, in sample S3 which recorded the highest value in cooking yield and moisture retention. Control sample scored the highest values in hardness cycle 1 and 2, springiness, Gumminess and chewiness. Sample S2 recorded the highest value in resilience, cohesiveness and springiness. While sample 3 recorded the lowest values in hardness cycle 1 and 2, cohesiveness, gumminess and chewiness. Sample S3 recorded the highest value in a* and b*, but the lowest value in L*.

*Keywords: Chicken products, oyster mushroom, quality attributes.*

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## 1- INTRODUCTION

Mushrooms are macro fungi with a fruiting body, which can yield erosion, can develop subterranean and have dimensions that can be seen with the naked eye, and can be picked by hand [1-2]. Mushrooms are considered as a complete and safest food, suitable for all age groups. This nutrient dense versatile food can be taken as a substitute of meat, fish, fruits, and vegetables [3]. About 20% of mushroom species worldwide are considered edible or

conditionally edible [4]. [5] reported that there was an increase in mushroom consumption has been observed in recent years. This trend may be attributed to several factors, including growing interest in their potential health benefits and diversification of culinary applications.

According to [6-7] Oyster mushroom (OM) this plant has garnered significant historical recognition for its therapeutic properties. Furthermore, it serves as a valuable dietary source due to its high nutrient content and the presence of numerous secondary metabolites possessing medicinal effects. Additionally, its ease of cultivation has likely contributed to its widespread adoption. The result by [8] show OM had rich source of dietary fiber, essential amino acids, carbohydrates, proteins, vitamins, and minerals. Additionally, they contain a variety of bioactive molecules with potential health benefits. These attributes, combined with their unique flavoring properties, excellent preservation qualities, and pleasant aroma, with both culinary and potential medicinal applications. The result by [9] revealed that a high content of protein, fiber, vitamins, minerals, and fatty acids were observed in oyster mushroom. Additionally, the presence of anti-nutrients was identified.

Chicken meat is considered as high-quality protein and essential micronutrients, indispensable for optimal human physiological function [10]. And several health benefits, including reduced risk of hypertension and type 2diabetes, as well as enhanced cardiovascular health [11]. The rise in chicken meat consumption is attributed to several factors: Versatility in culinary applications, coupled with its relatively lower cost compared to other protein sources, has contributed significantly to its widespread acceptance across diverse cultures and religions groups [12].

Consumer preference for consumption chicken burgers was increased recently for many reasons such as with taste, speed and accessibility, being a primary determinant. The diverse range of seasonings and preparation methods employed in burger production contributes significantly to their broad appeal [13-14].

Oyster mushrooms have been processed into numerous food products such as crispy mushroom, shredded mushroom, rendang mushroom, ca mushroom, satay mushroom, ice cream mushroom, risol mushroom, nuggets mushroom, mushroom fried rice, mushroom tomyam, oyster mushroom ketchup, soup powder and mushroom garang asem [15- 16].

The aim of this study is to partially replacement chicken meat with dried oyster mushrooms to satisfy economic conditions and increase quality and nutritional value.

## 2. Materials And Methods

### *2.1 Samples*

Oyster mushroom was obtained from Agricultural Research Center Giza, Egypt. Washed under running water for (30 s) then cut oyster mushroom into slices, make citric acid solution from (5 grams) citric acid powder in (1 liter) water then put oyster mushroom in solution for (10 min).It weighted then put it in glass trays and put glass trays under sun for 6 hours at a temperature (35±7°C) after that put it in place with fresh air. oyster mushroom is weighted every day and note until reaching a constant weight, in dehydrator. OM was grinded by mixer then weight and put in easy lock bags and making sure from let air out, according to [17]. Some supplements and equipment were used such as fresh chicken breasts, spices such as (salt, paper) and equipment such as air fryer.

**Table (1) Formulas of mushroom chicken burgers**

| Ingredients | Control | S1 | S2 | S3 |
|---|---|---|---|---|
| Chicken Breasts(g) | 49 | 39 | 26.5 | 17 |
| Mushroom powder(g) | - | 5 | 10 | 15 |
| Water | - | 5 | 12.5 | 17 |
| Spices(g) | 1 | 1 | 1 | 1 |
| Total(g) | 50 | 50 | 50 | 50 |

### 2.1.1 Preparing chicken burger

All ingredients have been blended until completely homogeneous, then it was formed as a burger, and it was put in the refrigerator for an hour according to [18].

### 2.1.2 Cooking:

Chicken burger was cooked in air fryer for 10 minutes at 160 °C then turns it to another side for 10 minutes again. Samples were weighted before and after cooking.

### 2.2.1 Chemical composition analysis

Moisture, protein, ash, crude fat, crude fiber, were determined according to the method described by [19]. Available carbohydrates content of the sample was calculated by the difference as mentioned by [20].

% Available carbohydrates (on dry basis) = 100 – (%Ash + %Fat +%Protein + %Fiber).

### 2.2.2 Cooking measurements

Cooking yield, moisture retention and shrinkage have been determined according to [21], while cooking loss become calculated consistent with the method mentioned by [22] using the following equation:

Cooking loss = [(weight of raw sample – weight of cooked sample) ÷ weight of raw sample] × 100→ (1)

$$\text{Cooking yield } (\%) = \frac{\text{Cooked weight}}{\text{Raw weight}} \times 100 \rightarrow (2)$$

$$\text{Moisture retention } (\%) = \frac{\text{Percent yield x moisture}}{100} \rightarrow (3)$$

### 2.2.3 Color measurement

Color was measured based on $L^*$, $a^*$, and $b^*$ values, where $b^*$ represents the degree of yellow-blue color ($a^*$ higher positive $b^*$ value indicates more yellow), was conducted by a Hunter lab model Precise Color Reader TCR 200 (BAMR Ltd., Claremont, South Africa). The $a^*$ represents the degree of red-green color (redder is indicated by a higher positive $a^*$value). $L^*$ represents lightness and ranges from zero to 100. To calibrate the colorimeter, a conventional white and black plate was used according to [23].

### 2.2.4 Texture profile analysis of cooked burger

Texture profile analysis (TPA) tests were performed on cooked samples at 4 ± 1 °C using a texture analyzer (Brookfield, CT3, Middleboro, MA, United States) to determine hardness (N), springiness, cohesiveness, and resilience. Samples were cut into (1 × 1 × 1 cm) from cooked burger and then held for equilibration to room temperature (20 °C), wrapped with plastic film for TPA. Test conditions were: probe (aluminum rectangular probe; 5 cm × 4 cm); test speed 5 mm/s; pre-test speed 2 mm/s, post-test speed 2 mm/s; compression 70% and 50 kg load cell. Three replicate measurements were taken for each sample per treatment and TPA parameters were determined as described by [24].

## 3. Results and Discussion

Table (2) showed the chemical composition results, sample S3 recorded the highest value in moisture with 45.20% followed by 43.43%, 41.85%, and 38.62% for sample S2, S1, and control respectively. Protein values were 51.67%, 42.51%, 34.80%, and 24.57% for control sample, S1, S2 and S3 respectively. The results for ash were 5.97%, 3.06%, 2.17% and 1.87% for S3, S2, S1 and control respectively. Sample S3 still recorded the highest value in crude fiber with 5.60%, followed by S2 with 4.14% then S1 with 2.07, the lowest value in control sample with 0.40%. On the other hand, control sample was the highest value in fat with 6.84%, S1, S2 and S3 which were 5.43%, 5.03% and 4.58% respectively. Total carbohydrate values were 14.10%, 9.56%, 5.99% and 0.61 for S3, S2, S1 and control respectively, significant differences ($P<0.05$) were observed between samples contain in

moisture, protein, ash, fiber, fat and carbohydrate. These results agreed with [18] confirm that the percentage of moisture, ash and fiber should increase with the percentage of replacement. [25] confirm the existence of a positive relationship between the value of protein and fat with the increase in the percentage of replacement.

**Table (2) Chemical composition of cooked burger**

| Samples | Chemical composition (% on wet weight basis) | | | | | |
|---|---|---|---|---|---|---|
| | Moisture | Protein | Ash | Crude fiber | Fat | Total carbohydrates |
| Fresh mushroom | 84.8 | 5.07 | 1.57 | 0.26 | 0.98 | 7.32 |
| Control | 38.62c | 51.67a | 1.87c | 0.40d | 6.84a | 0.61d |
| S1 | 41.85b | 42.51b | 2.17c | 2.07c | 5.43b | 5.99bc |
| S2 | 43.43ab | 34.80c | 3.06b | 4.14b | 5.03b | 9.56b |
| S3 | 45.20a | 24.57d | 5.97a | 5.60a | 4.58c | 14.10a |
| LSD at 0.05 | 1.876 | 1.858 | 0.308 | 0.382 | 0.431 | 1.410 |

*Control sample (chicken meat 100%), S1 (chicken burger with 10% oyster mushroom), S2 (chicken burger with 20% oyster mushroom) and S3 (chicken burger with 30% oyster mushroom) .*

Table (3) and figure (1) demonstrated the physical properties of investigated samples. Control samples had the highest lost weight from 50 g before cooking to 32.98 g after cooking. with 34.04% the percentage of weight loss decreases with the increase in the percentage of replacement, the weight of all samples before cooking was 50.0 g. after cooking weight were40.48g, 37.96g and 35.10g for S3, S2, S1 respectively, Since there is a direct relationship between the percentage of fat and percentage of moisture and the percentage of weight lost after cooking, this may be due to during cooking, especially grilling or air-frying, some of the fat in the burger patty melts and drips away, and cooking also causes water evaporation from the burger, contributing to weight loss. Such result was stated by [26] which confirmed the existence of a direct relationship between moisture and fat

Diameter of cooked burger recorded 6.79cm, 6.54 cm, 6.29 cm and 6.04 cm for S3, S2, S1and control sample respectively. Results showed that the more addition of mushroom powder increase, the more diameter decrease.

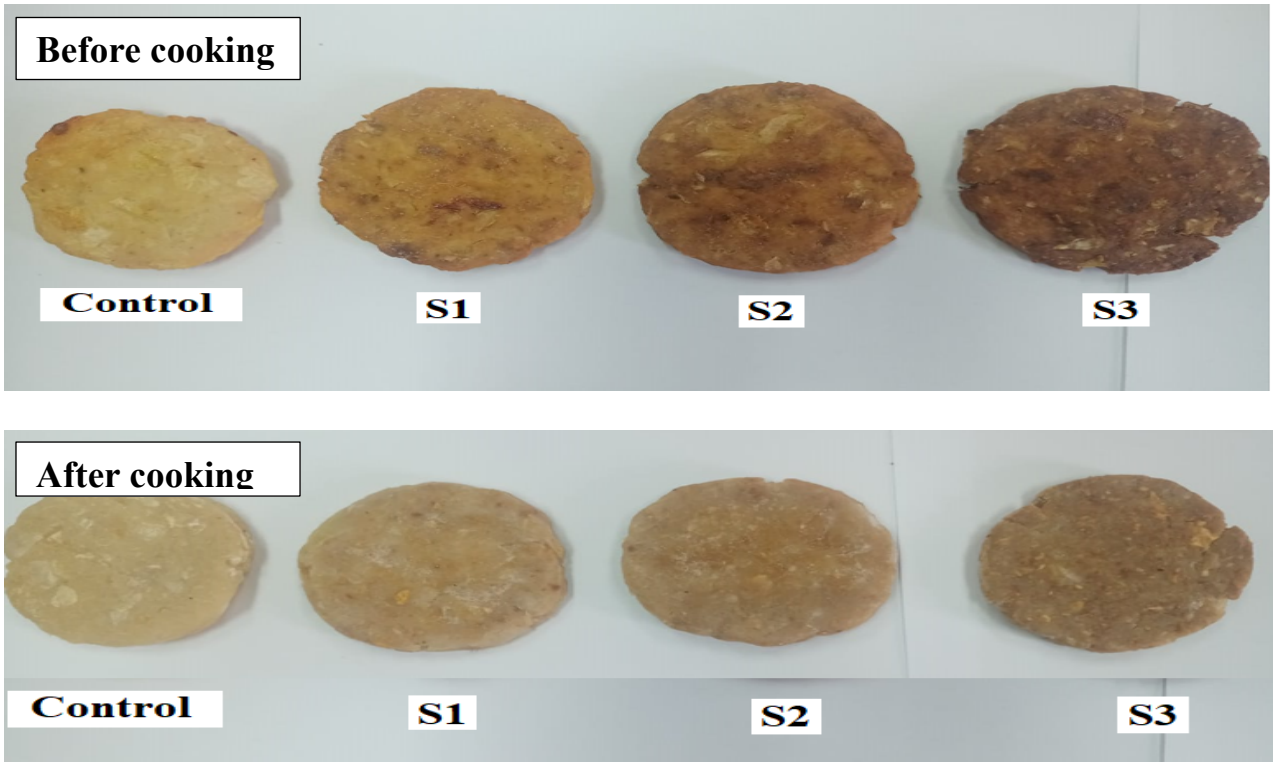
As stated in table (3) and figure (1) the value for shrinkage were 24.56%, 21.38%, 18.31% and 15.19% for control sample, S1, S2 and S3 respectively. This result agreed with [18] who confirmed that a reduction in shrinkage and shape distortion of cooked chicken burgers formulated with dried mushroom. This effect can be attributed to the binding and stabilizing properties of dried mushroom fibers. These fibers likely act by holding the meat particles together, thereby resisting structural changes during cooking. Furthermore, the degree of shrinkage reduction increased with the proportion of dried mushroom incorporated into the burger formulation. Interestingly, the control group exhibited a greater degree of shrinkage, highlighting the potential of dried mushroom as an anti-shrinkage agent in burger.

The addition of dried mushroom in chicken burgers led to increased cooking yield ($p \leq 0.05$). S3 exhibited the highest yield (80.95%) compared to other samples. The other samples values was 65.96%, 70.20% and75.91% for control, S1 and S2. It may be due to the properties of dietary fibers within the mushrooms, which form a three-dimensional matrix that effectively retains moisture and fat throughout the cooking process as confirmed by [27].

S3 exhibited the highest moisture retention (36.58%), compared to the control (25.48%). The values for S1 and S2 were 29.38% and 32.96 %. It observed that the more water retention increases the more weight loss decrease. Such result agreed with [28] which showed that protein substances can retain water

**Table (3) Physical properties:**

| Samples | Physical parameters of cooked burger | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Weight of uncooked burger(g) | Weight of cooked burger (g) | Diameter of un cooked burger (cm) | Diameter of cooked burger (cm) | Shrinkage (%) | Cooking loss (%) | Cooking yield (%) | Moisture retention (%) |
| Control | 50.01a | 32.98c | 8.01a | 6.04d | 24.56a | 34.04a | 65.96c | 25.48d |
| S1 | 50.01a | 35.10c | 8.01a | 6.29c | 21.38b | 29.80a | 70.20c | 29.38c |
| S2 | 50.01a | 37.96b | 8.01a | 6.54b | 18.31c | 24.09b | 75.91b | 32.96b |
| S3 | 50.01a | 40.48a | 8.01a | 6.79a | 15.19d | 19.05c | 80.95a | 36.58a |
| LSD at 0.05 | 0.038 | 2.497 | 0.028 | 0.176 | 2.201 | 4.991 | 4.994 | 2.845 |




**Figure(1) chicken burger samples before and after cooking**

The high contain of hardness cycle 1 was scored by control sample followed by S1, S2 and S3. In resilience test the high value scored by S1 followed by control sample then S3.the values of hardness cycle2 were 24.56 N, 17.38 N, 13.45 N and 12.15 N for control sample, S1, S2 and S3. The high value in Cohesiveness was recorded in S1 followed by S2 then control sample, agreed with [29]. But the highest value in springiness was scored by control sample followed by S1, agreed with [30]. Control sample scored the high value in gumminess followed by S1. The high value in chewiness was control sample followed by S1 and the lowest value was in S3. The significant results showed that there was a significant difference between all samples in hardness1, resilience, hardness cycle2, cohesiveness, springiness, gumminess and chewiness.

**Table (4) organoleptic evaluation of cooked burger**

| Samples | Organoleptic investigation of cooked burger | | | | | | |
|---|---|---|---|---|---|---|---|
| | Hardness cycle 1 (n) | Resilience | Hardness cycle 2 (n) | Cohesiveness | Springiness (mm) | Gumminess (n) | Chewiness (g.cm) |
| Control | 28.60a | 0.14b | 24.56a | 0.57ab | 4.81a | 16.20a | 77.80a |
| S1 | 19.24b | 0.27a | 17.38b | 0.66a | 5.10a | 12.62ab | 64.60b |
| S2 | 15.43bc | 0.23a | 13.45b | 0.61ab | 4.92a | 9.49bc | 46.60c |
| S3 | 12.44c | 0.19ab | 12.15b | 0.52b | 4.52a | 7.47c | 38.70d |
| LSD at 0.05 | 5.020 | 0.078 | 5.391 | 0.109 | 0.649 | 4.053 | 7.565 |

Color plays a pivotal role in food industry due to its impact on the aesthetic appeal of food products, as per consumer preferences [31]. Mushroom additives led to change to color of burger towards darkness. It may be due to L*, a* and b* were affected in physiochemical characteristics of mushroom as stated by [32]. Control samples scored the highest value of L*, while it recorded the lowest values in a* and b*. On the other hand, sample S3record the highest value in a* followed by S2, the lowest value was for control sample. In b* axis S3 scored the highest value followed by S2 then S1 and control sample, agreed with [33] which found that the a* value is employed to evaluate the extent of redness, which can serve as a gauge of doneness or the presence of certain conditions impacting meat color, such as the pink defect

**Table (5) Color measurement of cooked burger:**

| Samples | Color parameters | | |
|---|---|---|---|
| | L* | a* | b* |
| Control | 61.31a | 8.47d | 13.36c |
| S1 | 49.48b | 11.01c | 15.14bc |
| S2 | 45.93b | 14.68b | 17.33ab |
| S3 | 37.01c | 19.56a | 19.81a |
| LSD at 0.05 | 4.190 | 1.773 | 2.535 |

## 4. Conclusion

Dried mushrooms demonstrate potential as a functional food additive for meat products, specifically chicken burgers. The incorporation of dried mushrooms enhanced the chemical, physical, and sensory attributes of the burgers while also reducing production costs.

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# تأثير إضافة مشروم المحار المجفف شمسيا على القيمة الغذائية والخواص الحسية لبرجر الدجاج

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**الملخص العربى:**
هدف البحث الحالى إلى دراسة تأثير إضافة مشروم المحار المجفف شمسيا على القيمة الغذائية والخواص الحسية لبرجر الدجاج. كانت نسب الاستبدال (30،20،10%) ، تم تقدير التركيب الكيميائى والخصائص الحسية و الطبيعية لعينات المشروم وعينات البرجر. أظهرت النتائج ارتفاع محتوى مشروم المحار من البروتين والرماد (5.07،1.57) على التوالي، وانخفاض محتواه من الدهون والألياف. كانت العينة الاولى(10%) اعلى نسبة فى البروتين، بينما ارتفع محتوى العينة الثالثة(30%) من حيث الرماد والالياف والكربوهيدرات مع انخفاض نسبة فى الدهون. وأوضحت نتائج التقييم الحسى أن العينة الثالثه اقل قيمة فى الانكماش والفقد بالطهى، لوحظ وجود علاقه عكسية معنوية بين "الانكماش والفقد بالطهى" وبين "عائد الطهى و القدرة على امتصاص الرطوبة"، وهذا ادى بدوره الى ارتفاع الوزن وقطر برجر الدجاج بعد الطهى. وقد أظهرت العينة الثالثه اعلى قيمه فى كل من عائد اطهى والقدره على الاحتفاظ بالرطوبة. أحرزت عينة البرجر الكنترول أعلى قيمة فى كلا من دوره الصلابه الاولى ، دوره الصلابة الثانية، سرعة الارتداد، اللزوجة و المضغ. وسجلت العينة الثانية اعلى قيمة فى المرونة و التماسك و الارتداد. وسجلت العينة الثالثة أيضا اقل قيمة فى دورة الصلابة الاولى و الثانية ، التماسك ، اللزوجة و المضغ ، بينما سجلت اعلى قيمة فى قيم a* ، b* ، و اقل قيمة فى L*.

الكلمات الكاشفة: منتجات الدواجن, مشروم المحار, سمات الجودة

الاستشهاد الي:
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