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THE EFFECT OF ADDING DIFFERENT RATES OF MUSHROOM POWDER TO THE WHEAT FLOUR ON THE NUTRITIONAL VALUE OF PROTEINS, SENSORY AND PHYSICAL PROPERTIES OF LOCAL BREAD

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Abstract: A current study was conducted to determine the effect of adding different rates of mushroom powder in the dough on the chemical composition and improving the nutritional value of domestic wheat flour. Three rates of mushroom powder (5%, 10%, and 15%) were added to wheat flour to achieve the aim above. The experiment was arranged using a complete randomized design (CRD) and means were compared at 0.05 using the Duncan test. Results of chemical analysis showed that domestic wheat flour contents of protein, fat, ash, moisture, fibers, carbohydrates, and pH were 11.1, 0.7, 1, 14.8, 1.7, 70.7, and 6.7 respectively. While these contents in mushroom powder amounted to 36, 1.7, 1.3, 4, 12, 6.4, 42.2, and 5.6 respectively. Results also indicated that adding different rates of mushroom powder increased protein, ash, fibers, and fat, while, the percentage of carbohydrates was decreased compared to wheat flour without mushroom powder. Enhancing domestic wheat flour with mushroom powder can improve the nutritional value and the taste of bread.

Keywords: Wheat Flour, Mushroom Powder, Chemical Contents, Nutritional Value.

1. Introduction

Grain crops are the main food for most people due to the potential of producing these crops in large quantities, ease of storage and transport it, low cost and its contents of energy, protein and carbohydrates [1]. Grains occupied most cultivated area worldwide and produce more than 60% of global production which provides energy, vitamins, minerals and proteins for world population. Wheat is one of most cultivated crop and considered an essential food that human relied on for a long time to maintenance the metabolic processes inside human body [2].

Mushroom (Agaricus bisporus) is the most consuming type in many Asian countries [3], [4] and it used as a food due to the nutritional value and high content of protein (30-40% of dry weight), vitamins, minerals, and low content of fat and carbohydrates, in addition to its favorite taste and distinguish smell [5], [6]. The interest of enhancing bread as a main human food with some nutritional substances has been raisin and many studies have been conducted to improve its nutritional value which becomes a target to be achieved in most countries for sustainable food security [7].

Many studies were established to integrate the flour of some crop with wheat flour, for in-stance, cowpea flour was mixed with wheat flour in ratios of 5.0, 10, 15, 20 and 30% to make bread and the results showed some differences as protein and ash rates were increased in the new bread, while, carbohydrates were decreased and the sensory evaluation indicated that replace 10% of wheat flour with cowpea flour was achieved the best evaluation [8]. Another study was replaced wheat flour with 0, 5, 10, 15, 20 and 30% of mung bean (maash) flour and found a decreasing in moisture, protein and ash content and sensory evaluation indicated that replace 10% of wheat flour with mung bean flour was achieved the best evaluation [9]. The objectives of current study are enhancing the nutritional value of bread by adding different ratios of mushroom flour and improve bread proteins.

2. Materials and Methods

All experiments were carried out in laboratories of Department of Food Sciences, Faculty of Agriculture, University of Kufa, Najaf, Iraq, and the chemical analysis were done in Ministry of Science and Technology/ Environment and Water Office laboratories/ Baghdad. Raw materials: Local wheat flour (cv. Rehab) was obtained from governmental mill in Najaf province 2020 white mushroom (*Agaricus sbisporus*) was obtained from local market in Najaf. Preparation of wheat flour and mushroom powder: Local wheat flour (cv. Rehab) and white mushroom were kept at 4^0C until used in preparing flour mixtures. The mushroom was washed and cut into small pieces then put in oven at 105^0C for 3 hours after that, pieces were ground and sifted to get the powder. Preparation of flour mixtures: Mixtures of wheat flour and mushroom powder were prepared as follows:

1- Local wheat flour (100%).

2- White mushroom powder (100%).

3- Local wheat flour (95%) + White mushroom powder (5%).

4- Local wheat flour (90%) + White mushroom powder (10%).

5- Local wheat flour (85%) + White mushroom powder (15%).

Estimation of chemical structure: Chemical structure of wheat flour and mushroom powder was done in by estimating moisture, ash, protein, fat, fibers, carbohydrates and amino acids Ministry of Science and Technology/ Environment and Water Office laboratories/ Baghdad.Estimation of moisture: Moisture percentage was estimated using slandered method of American Association of Cereal Chemists [10] as follows:

Moisture % = (Sample weight – sample weight after drying/ sample weight) x 100. Estimation of protein: Protein percentage was estimated by calculated the total nitrogen using micro-Kjeldahl [11] as follows:

$$\text{Nitrogen percentage} = \frac{\text{HCL volume (ml)} \times \text{molar } 0.05 \times 0.014}{\text{Sample weight (g)}} \times 100$$

Protein % = Nitrogen percentage x 6.25

Estimation of fat: Fat percentage was estimated in studied samples using Soxhlet [11] as follows:

$$\text{Fat\%} = \frac{\text{Fat weight}}{\text{Sample weight}} \times 100$$

Estimation of ash: Ash percentage was estimated following [1].

Estimation of fibers: Fibers percentage was estimated following [11] method.

Carbohydrates determination: Carbohydrates were estimated as follows:

Carbohydrates % = 100 – (protein % + fat % + ash % + fibers %). Statistical analysis: Complete randomized design (RCD) was used to arrange treatments and the differences between means of treatments were compared using Duncan test (DMRT) [12], at $P \leq 0.05$ then data were analyzed using GenStat V.12.1.

3. Results and Discussion

Chemical structure of wheat flour with added ratios of mushroom powder. Protein: There were significant differences between all treatments and results of Fig 1 showed that the percentage of protein in mixtures of

wheat flour and mushroom powder (100% wheat flour, 100% mushroom powder, 5% mushroom powder, 10% mushroom powder and 15% mushroom powder) amounted 11.1, 36, 12.6, 13.7 and 14.8% respectively. As the highest protein percentage was recorded in the mixture of 15% mushroom powder, while the lowest protein percentage recorded when mixing 5% of mushroom powder with wheat flour. The percentage of protein in mushroom powder alone amounted 36% and this is consistent with [13] who reported 31.3% percentage of protein in mushroom. Moreover, [14]–[16] found that adding 15% of dry mushroom to wheat flour was increased the percentage of protein to 15.7%. The increasing of protein ratio is due to the presence of essential and nonessential free amino acids in mushroom [17]. The amount and type of protein is controlled produced bread [18], and the content of mushroom powder of protein is higher than any source of flour [19].

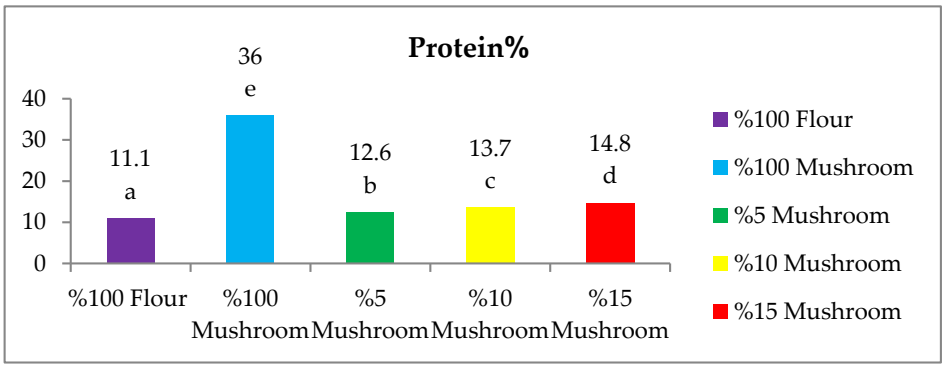

Figure 1. Protein percentage in studied mixtures.

*Each value in the figure presents an average of two recordings.

**Values with different letter mean there were significant differences between means at P ≤ 0.05.

Fat: Results of chemical analysis of tested mixtures (100% wheat flour, 100% mushroom powder, 5% mushroom powder, 10% mushroom powder and 15% mushroom powder) showed significant differences between treatments except for 5% and 10% mushroom powder which showed no significant differences Fat percentage recorded 0.75, 1.7, 2.05, 2.55 and 2.25 respectively as the highest percentage of fat was recorded when 15% of mushroom powder was added to wheat flour compare to lowest value recorded in wheat flour only (Fig 2). These results are in agreement with [13] who reported 1.9% of fat in mushroom and also [14]–[16] found that adding 15% of dry mushroom to wheat flour was increased the percentage of fat to 2% which may related to nutrition method during planting [13].

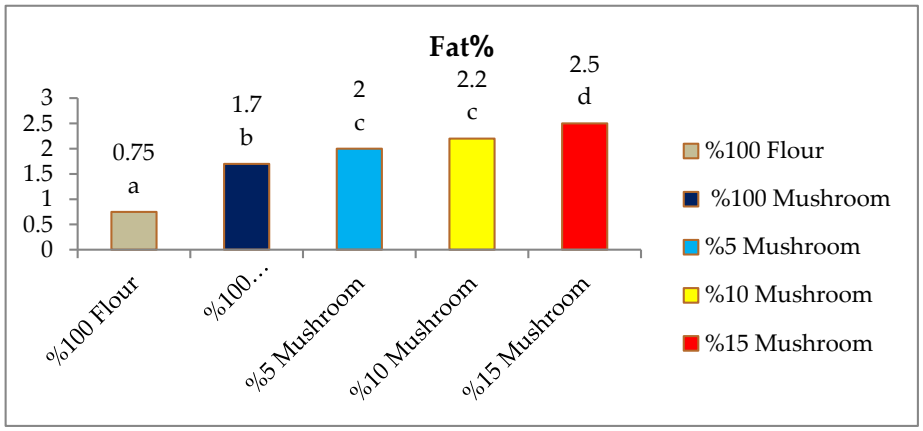

Figure 2. Fat percentage in studied mixtures.

*Each value in the figure presents an average of two recordings.

**Values with different letter mean there were significant differences between means at P ≤ 0.05.

Ash: There were significant differences between treatments as the ash percentage was recorded 1.05, 1.35, 1.75, 2.35 and 3.15% respectively in the studied mixtures when the highest percentage of ash recorded after 15%

of mushroom powder was added to wheat flour, while the lowest percentage of ash recorded when 5% of mushroom powder was added. [14]–[16] found that adding 15% of dry mushroom to wheat flour was increased the percentage of ash to 7%. It is important to increase mineral content in food such as ash for better health [19] and the percentage of ash is differ from sample to another depending on extracting percentage [20].

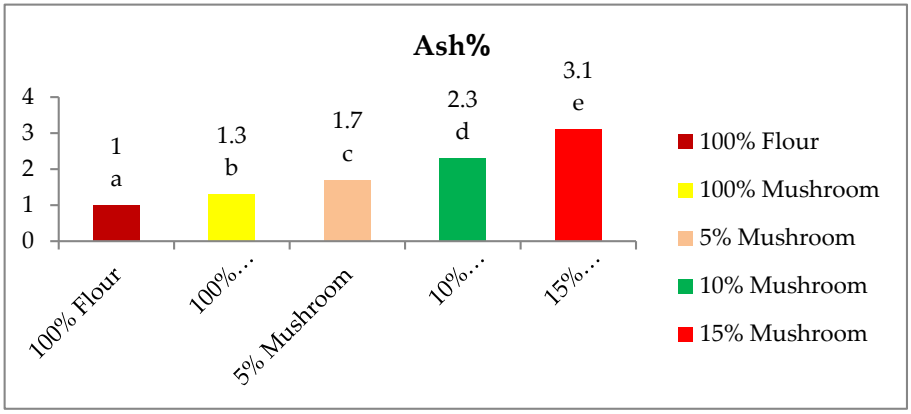

Figure 3. Ash percentage in studied mixtures.

*Each value in the figure presents an average of two recordings.

**Values with different letter mean there were significant differences between means at P ≤ 0.05.

Moisture: There were significant differences between all treatments in the moisture percentage as it recorded 14.8, 12.4, 13.3, 14.1 and 15.3% respectively in studied mixtures (Fig 4). The higher average of moisture was found when 15% of mushroom powder was added to wheat flour, while, the lowest percentage recorded when just 5% of mushroom powder added. [14]–[16] found that adding 15% of dry mushroom to wheat flour was increased the moisture to 10.6%. Results of current study are in agreement with [21] who found 14.9% of moisture in mushroom. The increasing of moisture rate may occur due to moisturizing processes that take place on the grains before grinding [22]. The percentage of moisture in dry mushroom is about 13.08 to 13.94% [23] and these ratios are close to the finding of current study.

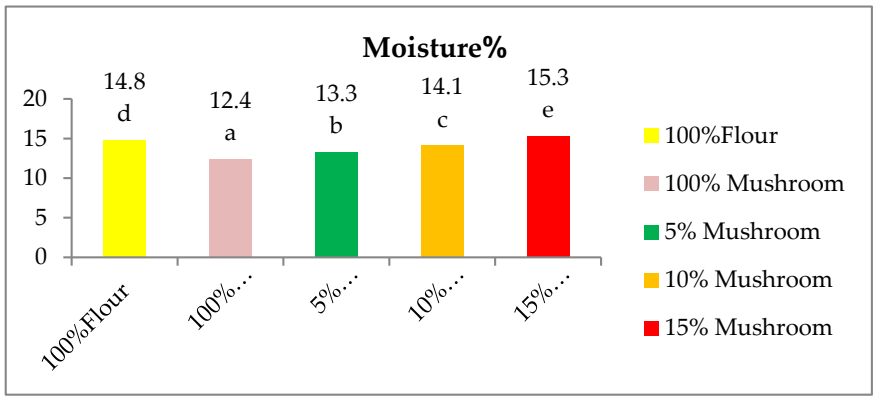

Figure 4. Moisture percentage in studied mixtures.

*Each value in the figure presents an average of two recordings.

**Values with different letter mean there were significant differences between means at P ≤ 0.05.

Fibers: There were significant differences between treatments in term of fibers content. Fig 5 showed the average of fibers in the studied mixtures as it recorded 1.7, 6.4, 2.7, 3.1 and 3.8% respectively. Among all tested mixtures, adding 15% of mushroom powder was recorded the highest rate of fibers 3.8% compare to 1.7% in wheat flour only, while adding 5% of mushroom powder recorded the lowest fibers rate of 2.7%. Many studies have been reported that adding 15% of mushroom powder to wheat flour increased fibers content by 3.9% [14]–[16]. The percentage of fibers in the local wheat flour in current study 1.7% is higher than what [24] found as

they reported just 0.72% of fibers in wheat flour. Results of current study indicated significant increasing of fibers in mushroom powder 6.4% and this percentage is close to what [17] found as they mentioned 8.6% of fibers in dry mushroom. Fibers content is increased when adding mushroom powder to wheat flour from 2.7% to 9.7% [13].

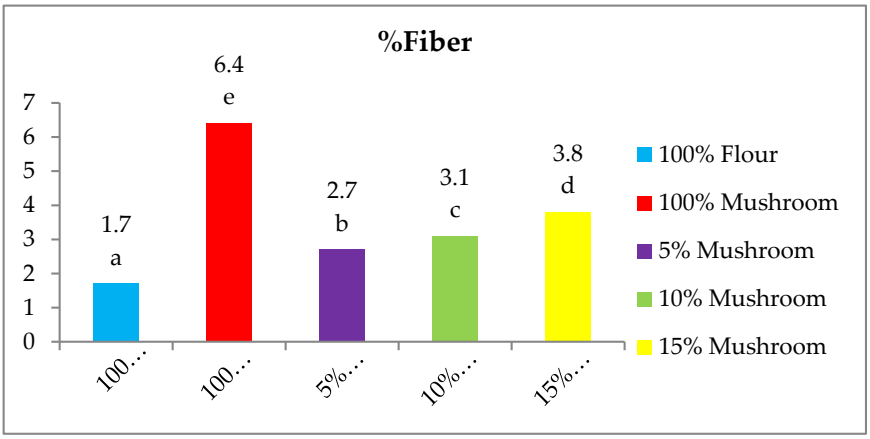

Figure 5. Fibers percentage in studied mixtures.

*Each value in the figure presents an average of two recordings.

**Values with different letter mean there were significant differences between means at P ≤ 0.05.

Carbohydrates: Results of chemical analysis showed that there were significant differences between treatments in term of carbohydrates content. Tested mixtures were recorded 70.7, 42.2, 67.7, 64.6 and 60.5% of carbohydrates respectively and the highest percentage 67.7% was recorded when 5% of mushroom powder added to wheat flour compare to 70.7% in wheat flour only, while, the lowest carbohydrates content (60.5%) was recorded after adding 15% of mushroom powder. [13] reported 40.8% carbohydrate in dry mushroom which is lower than the percentage of current study that recorded 42.2% in mushroom powder, while, [14]–[16] mentioned that adding 10% of dry mushroom was increased the carbohydrates percentage to 64.1%. The difference in carbohydrates percentage is due to the different nutrition method during planting [13]. [17] reported 65.4% of carbohydrates in dry mushroom and this percentage is higher than current study result which recorded 42.2%. The percentage of carbohydrates is gradually decreases when the proportion of added mushroom powder to wheat flour increases [13].

To conclude, adding 5, 10 and 15% of mushroom powder was increased the percentage of protein, ash, fibers, and fat and decreased carbohydrates percentage in comparison with wheat flour only. Moreover, adding mushroom powder was improve the taste and the smell of products in all treatments.

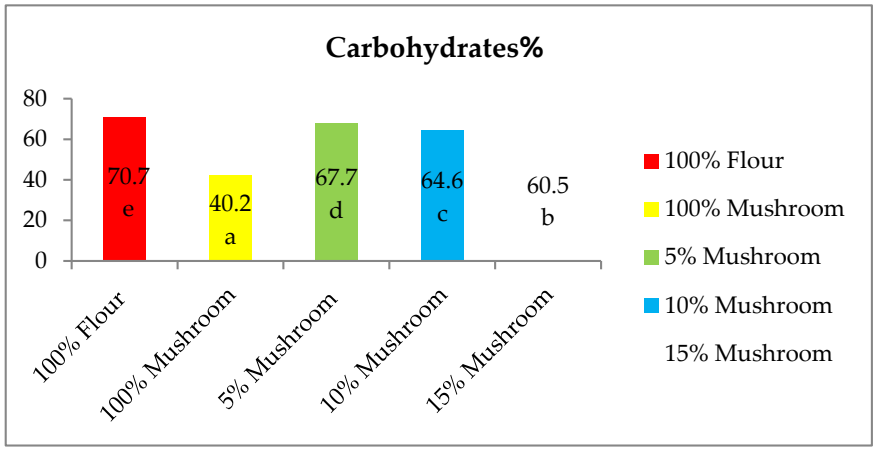

Figure 6. Carbohydrates percentage in studied mixtures.

*Each value in the figure presents an average of two recordings.

**Values with different letter mean there were significant differences between means at P ≤ 0.05.

4. Conclusion

We conclude that The protein, fat, ash, moisture, fibers, carbs, and pH contents of domestic wheat flour showed that adding various amounts of mushroom powder enhanced protein, ash, fibers, and fat while lowering the proportion of carbohydrates when compared to wheat flour without mushroom powder. Mushroom powder can enhance domestic wheat flour, enhancing both the nutritional content and flavor of bread.

Supplementary Materials:

No Supplementary Materials.

Author Contributions:

S. H. Al-Atijawi; methodology, writing—original draft preparation, R. S. Almusawy; writing—review and editing, S. H. Al-Atijawi; paraphrasing. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement:

No Data Availability Statement.

Conflicts of Interest:

The authors declare no conflict of interest.

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4. References

[1] A. Sidnell, "Essentials of Human Nutrition," *Nutr Bull*, vol. 33, no. 2, 2008, doi: 10.1111/j.1467-3010.2008.00698.x.

[2] T. Mahmood, T. Hameed, N. R. Siddiqui, A. Mumtaz, N. Safdar, and T. Masud, "Effect of environmental changes on phytic acid content of wheat (Triticum aestivum)," *Pakistan Journal of Nutrition*, vol. 9, no. 5, 2010, doi: 10.3923/pjn.2010.447.451.

[3] F. M. N. A. Aida, M. Shuhaimi, M. Yazid, and A. G. Maaruf, "Mushroom as a potential source of prebiotics: a review," *Trends in Food Science and Technology*, vol. 20, no. 11–12. 2009. doi: 10.1016/j.tifs.2009.07.007.

[4] Q. Hu *et al.*, "Polyphenols-rich extract from: Pleurotus eryngii with growth inhibitory of HCT116 colon cancer cells and anti-inflammatory function in RAW264.7 cells," *Food Funct*, vol. 9, no. 3, 2018, doi: 10.1039/c7fo01794d.

[5] Y. Cuptapun, D. Hengsawadi, W. Mesomya, and S. Yaieiam, "Quality and quantity of protein in certain kinds of edible mushroom in Thailand," *Kasetsart Journal - Natural Science*, vol. 44, no. 4, 2010.

[6] E. A. Adebayo, J. K. Oloke, D. A. Aina, and T. C. Bora, "ANTIOXIDANT AND NUTRITIONAL IMPORTANCE OF SOME PLEUROTUS SPECIES," *J Microbiol Biotech Food Sci*, vol. 3, no. 4, 2014.

[7] T. Lafarga, E. Gallagher, D. Walsh, J. Valverde, and M. Hayes, "Chitosan-containing bread made using marine shellfishery byproducts: Functional, bioactive, and quality assessment of the end product," *J Agric Food Chem*, vol. 61, no. 37, 2013, doi: 10.1021/jf402248a.

[8] R. S. Ali, L. F. H. Al-Obaidi, and M. A. Alssirag, "Physical and nutritional properties of bread from wheat flour fortification with cowpea (Vigna unguiculata) flour," *Plant Arch*, vol. 19, 2019.

[9] "Antimicrobial, antioxidants activity and Nutritional Properties of High Protein Breads from Vignaradiata," *Indian J Public Health Res Dev*, 2020, doi: 10.37506/ijphrd.v11i4.9192.

[10] Anonymous and AACC, "Approved Methods of the American Association of Cereal Chemists (10th edn).Method 08-01-16," *American Association of Cereal Chemists*, 2000.

[11] AOAC, "The Association of Official Analytical Chemists International," *Official Methods of Analysis*, vol. 38, no. 8, 2016.

[12] D. B. Duncan, "Multiple Range and Multiple F Tests," *Biometrics*, vol. 11, no. 1, 1955, doi: 10.2307/3001478.

[13] M. S. Aishah and W. I. Wan Rosli, "The effect of addition of oyster mushroom (Pleurotus sajor-caju) on nutrient composition and sensory acceptation of selected wheat- and rice-based products," *Int Food Res J*, vol. 20, no. 1, 2013.

[14] J. Reguła and M. Siwulski, "Dried Shiitake (Lentinulla Edodes) and Oyster (Pleurotus Ostreatus) Mushrooms As a Good Source of Nutrient," *ACTA Acta Sci. Pol., Technol. Aliment*, vol. 6, no. 4, 2007.

[15] P. Kalač, "Chemical composition and nutritional value of European species of wild growing mushrooms: A review," *Food Chemistry*, vol. 113, no. 1. 2009. doi: 10.1016/j.foodchem.2008.07.077.

[16] B. A. Wani, R. H. Bodha, and A. H. Wani, "Nutritional and medicinal importance of mushrooms," *Journal of Medicinal Plants Research*, vol. 4, no. 24. 2010. doi: 10.5897/jmpr09.565.

[17] Y. Biao, X. Chen, S. Wang, G. Chen, D. J. Mcclements, and L. Zhao, "Impact of mushroom (Pleurotus eryngii) flour upon quality attributes of wheat dough and functional cookies-baked products," *Food Sci Nutr*, vol. 8, no. 1, 2020, doi: 10.1002/fsn3.1315.

[18] F. MacRitchie, "Baking quality of wheat flours," *Adv Food Res*, vol. 29, no. C, 1984, doi: 10.1016/S0065-2628(08)60058-0.

[19] J. N. C. Okafor, G. I. Okafor, A. U. Ozumba, and G. N. Elemo, "Quality characteristics of bread made from wheat and nigerian oyster mushroom (Pleurotus plumonarius) powder," *Pakistan Journal of Nutrition*, vol. 11, no. 1, 2012, doi: 10.3923/pjn.2012.5.10.

[20] G. A. Jeong, J. Park, K. H. Kim, and C. J. Lee, "Comparison of structure and physicochemical properties of commercial domestic and imported wheat starch," *Korean Journal of Food Science and Technology*, vol. 53, no. 5, 2021, doi: 10.9721/KJFST.2021.53.5.521.

[21] W. Leonard, P. Zhang, D. Ying, and Z. Fang, "Application of extrusion technology in plant food processing byproducts: An overview," *Compr Rev Food Sci Food Saf*, vol. 19, no. 1, 2020, doi: 10.1111/1541-4337.12514.

[22] Y. A. Shah *et al.*, "Biochemical and nutritional properties of wheat bulgur: A review," *Journal of Food Processing and Preservation*, vol. 46, no. 10. 2022. doi: 10.1111/jfpp.16861.

[23] N. Doğan, C. Doğan, M. Çam, and İ. Hayoğlu, "Optimization and comparison of three cooking methods for wheat flour-oyster mushroom (P. ostreatus) powder composite chips," *J Food Process Preserv*, vol. 44, no. 11, 2020, doi: 10.1111/jfpp.14873.

[24] A. Qayyum *et al.*, "Rheological and Qualitative Assessment of Wheat-Pea Composite Flour and its Utilization in Biscuits," *Pakistan Journal of Agricultural Research*, vol. 30, no. 3, 2017, doi: 10.17582/journal.pjar/2017.30.3.258.265.