Study of organoleptic and technological properties of minced meat products with addition of mushroom powder

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Abstract. The authors propose a new type of minced meat products with the addition of dry mushrooms in powder form. It provides high protein content and good taste of finished products. The article presents the results of experimental studies on the enrichment of minced meat products with mushroom powder. Tasting analysis showed that the best organoleptic indicators have samples of culinary products with the content of enriched mushroom powder in 10%. A further increase above 15% adversely affects the organoleptic characteristics of the finished culinary products. Adding of mushroom powder to the amount of minced meat products allowed to improve consumer properties, reduce calorie content, as well as produce functional products.

1 Introduction

Food is an integral part of human life. The search and involvement in the technological process of raw materials that have a balanced chemical composition and have a functional effect is the key to creating high-quality food products that have a beneficial effect on the human body. Combination of various types of raw materials for achieve a certain type of nutrient, micro- and macroelement, vitamin, fatty acid balance is one way of technology development. Cultivated mushrooms have a balanced composition of nutrients, they also grow quickly, without requiring expensive equipment for growing, are easily processed, have a pleasant taste and aroma when ready [1]. Therefore, such raw materials can cope the protein deficiency, that remains as a major problem for humanity. Mushrooms have antioxidant, antitumor and anti-inflammatory properties [2]. Thereby, the use of dry mushrooms in powder form in the technology of minced meat products as an alternative source of protein and nutrients is very relevant.

2 Experimental

The aim of research is the analysis of organoleptic and technological properties of minced meat products with addition of powdered cultivated edible mushrooms for enrichment such meat products with functional ingredients.

Edible cultivated mushrooms are widely represented on the modern market, such as (Agaricus bisporus bicuspid chamignons, Brazilian champignon Agaricus subrufescens, Common oyster mushroom Pleurotus ostreatus, Flammulin or Enokitake Flammulina velutipes, Edible lentil or shiitodes etc.). The nutritional value of mushrooms depends on the species, stage of development and environmental conditions [3]. Depending on the species, raw protein content in mushrooms ranges from 12 to 35%. The composition of free amino acids is very different. In general, they are rich in threonine and valine. However, they are poor in sulfur-containing amino acids.

Total carbohydrate content in mushrooms ranges from 26-82%. It based on dry matter in different mushrooms. Carbohydrate profile of mushrooms is represented by starch, pentoses, hexoses and disaccharides. The raw fibrous composition of the fungus consists of the frequently assimilated polysaccharides and chitin.

Edible mushrooms could be a source of many different nutraceuticals such as unsaturated fatty acids, phenolic compounds, tocopherols, ascorbic acid and carotenoids. Thus, they might be used directly in diet and promote health, taking advantage of the additive and synergistic effects of all the bioactive compounds present.

Edible mushrooms have low calorie content. They are usually low in lipids with a higher proportion of polyunsaturated fatty acids. Mushrooms do not contain cholesterol, but they have ergosterol, which acts as a precursor to the synthesis of vitamin D in the human body.

Nutritional value of various types cultivated edible mushrooms, which are planned to be used in the technology of minced meat products, are represented in Table 1 [3].

High nutritional value determines the widespread use of mushrooms in the technology of low-calorie products. As can be seen from the Table I, mushrooms have the low content of fats. Also, they are an alternative source of protein.

Mushrooms take a leading position in terms of protein content compared to vegetables [4]. High biological value of mushrooms proteins is due to the content of essential amino acids. The content of essential amino acids in proteins of fungi compared to the “ideal protein” (Table 2) [2].
A significant content of essential amino acids closes to their amount in the "ideal protein", as we can see from the Table 2. It allows us to predict the prospects of using this type of raw material as a source of high-grade protein.

Table 1. Nutritional value of cultivated edible mushrooms (in dry matter gram per 100 g).

| Kind of mushrooms | Protein | Fat     | Carbohydrates | Ash   |
|-------------------|---------|---------|---------------|-------|
| Agaricus bisporus | 33.48   | 3.10    | 46.17         | 5.70  |
| Pleurotus ostreatus | 30.40  | 2.20    | 57.60         | 9.80  |
| Flammulina velutipes | 17.60  | 1.90    | 73.10         | 7.40  |
| Lentinula edodes    | 32.93   | 3.73    | 47.60         | 5.20  |
| Vovarella volvaceae | 37.50   | 2.60    | 54.80         | 1.10  |

Turkey meat contains proteins. The amount and ratio of essential amino acids in proteins of mushrooms, compared with the "ideal protein".

Table 2. The content of essential amino acids in proteins of mushrooms, compared with the "ideal protein".

| Name of amino acids | Amino acid content, g per 100 g of protein |
|---------------------|------------------------------------------|
|                     | Perfect protein | Oyster mushroom | Shiitake | Enoki | Flammulina velutipes | Vovarella volvaceae | Agaricus bisporus | Pleurotus eryngii | Straw mushroom |
| Essential amino acids | 36.0 | 42.7 | 45.7 | 77.9 | 31.6 | 39.4 | 69.3 | 58.8 | 43.8 |
| Valine              | 5.0  | 5.0  | 5.2  | 7.1  | 3.0  | 2.7  | 8.1  | 4.3  | 6.3  |
| Isoleucine          | 4.0  | 3.8  | 4.7  | 11.9 | 3.6  | 4.0  | 16.4 | 2.3  | 5.3  |
| Leucine             | 7.0  | 8.8  | 9.2  | 11.4 | 5.6  | 8.2  | 14.3 | 2.3  | 7.3  |
| Lysine              | 5.5  | 5.0  | 5.6  | 15.4 | 3.9  | 5.2  | 13.0 | 0.6  | 6.2  |
| Methionine +Cystine | 3.5  | 7.5  | 6.0  | 7.1  | 3.8  | 5.4  | 4.3  | 15.6 | 6.7  |
| Threonine           | 4.0  | 4.2  | 4.8  | 7.8  | 3.4  | 5.0  | 4.3  | 3.0  | 5.2  |
| Phenylalanine +Tyrosine | 6    | 6.9  | 9.0  | 13.7 | 7.1  | 7.0  | 5.6  | 9.7  | 6.7  |
| Tryptophan          | 1    | 1.5  | 1.2  | 3.4  | 1.2  | 1.9  | 3.2  | 1.0  | 0.1  |
| Nonessential amino acids | -    | 54.0 | 55.2 | 100.4 | 34.7 | 50.9 | 78.0 | 34.5 | 52.7 |
| Arginine            | -    | 5.4  | 5.3  | 12.8 | 4.3  | 5.5  | 8.8  | 2.4  | 4.9  |
| Glutamic acid       | -    | 16.5 | 11.5 | 27.8 | 7.3  | 11.9 | 12.7 | 6.3  | 14.0 |
| Alanine             | -    | 8.2  | 7.8  | 16.9 | 7.3  | 10.5 | 22.9 | 7.3  | 8.6  |
| Glycine             | -    | 6.1  | 10.3 | 8.0  | 4.1  | 5.4  | 6.7  | 2.6  | 6.9  |
| Asparaginic acid    | -    | 9.8  | 7.8  | 16.9 | 7.3  | 10.5 | 22.9 | 7.3  | 8.6  |
| Proline             | -    | 1.7  | 3.4  | 12.2 | 1.9  | 3.0  | 8.2  | 7.7  | 2.1  |
| Serine              | -    | 4.2  | 4.7  | 7.0  | 2.7  | 3.4  | 7.4  | 2.9  | 4.2  |
| Histidine           | -    | 1.9  | 2.2  | 5.5  | 1.5  | 2.9  | 2.0  | 1.3  | 2.3  |
The cutlets were prepared according to the traditional technological scheme: preparation of meat and mushroom raw materials, dosage of the powdered and other components according to the recipe, mixing until the components are evenly distributed over the volume of minced meat, molding and breading of cutlets, heat treatment.

Quality control of cutlets, as well as comparison of control and experimental samples, showed that adding up to 10.0% of mushroom powder (instead of bread) to the recipe has a positive effect on the organoleptic characteristics of the samples.

The values of quality indicators of control and experimental samples are presented in the Table 3.

Table 3. Organoleptic characteristics of research and control samples.

| Parameter name         | Poultry cutlet (control) | Cutlet with mushroom powder (sample 1) | Cutlet with finely ground mass of cooked mushrooms (sample 2) |
|------------------------|--------------------------|----------------------------------------|---------------------------------------------------------------|
| Appearance             | Attractive cutaway appearance, evenly mixed minced meat | Well defined, pleasant, without extraneous smells and odors | Well defined, without extraneous smells and odors |
| Sectional view         | All components of the minced meat are evenly distributed throughout the volume | | |
| Smell and taste        | Pleasant, characteristic of this product, without strangers, with the aroma of spices, moderately salty | | |
| Consistency            | Juicy, not crumbly       | Tender, juicy, not crumbly       | Juicy, not crumbly |

Tender consistency appeared in sample 1 (with the addition of powdered mushrooms). The smell of cutlets with mushroom raw materials was more pleasant. The use of mushroom raw materials in the production of minced meat products did not negatively affect the color of the finished product.

Results of organoleptical scores indicated that cutlets prepared from turkey were rated “very palatable” and were comparable with control cutlet prepared from chicken meat. It can be concluded that, turkey meat can be successfully used for preparation of cutlets of acceptable quality.

Table 4 shows the chemical composition of the developed samples. For the quality of minced meat, as well as finished products corresponds to such a rheological indicator as water-binding ability.

During cooking, the free moisture contained in the mushrooms is removed, and bound contains protein and hydrocarbon structures. As a result of fine grinding of the tissues of meat and mushrooms, the particle size decreases, and their total surface increases. Moisture turns into surface-bound moisture; the losses of cutlets during heat treatment were insignificant. The use of mushroom raw materials in the production of cutlets affected the content of the mass fraction of moisture.

Table 4. Chemical composition of the developed samples.

| Indicator                  | Poultry cutlet (control) | Cutlet with mushroom powder (sample 1) | Cutlet with finely ground mass of cooked mushrooms (sample 2) |
|----------------------------|--------------------------|----------------------------------------|---------------------------------------------------------------|
| Humidity, %                | 51.2                     | 63.2                                   | 64.8                                                          |
| Protein, %                 | 18.3                     | 19.2                                   | 18.9                                                          |
| Fat, %                     | 10.2                     | 6.4                                    | 6.8                                                           |
| Carbohydrate, %            | 13.4                     | 8.4                                    | 7.2                                                           |
| Ash, %                     | 6.4                      | 6.8                                    | 6.4                                                           |
| Energy value, kcal         | 218.6                    | 168                                    | 165.6                                                         |

4 Conclusion

Indicated functional properties of edible cultivated mushrooms allow their use in powdered form in the production of minced meat products. It helps to improve consumer properties, reduce calorie content, as well as produce functional products.

Thus, it was found that to obtain minced meat products of a functional purpose, it is advisable to introduce mushroom into their recipe in an amount of up to 10.0%. It should be noted that the inclusion of mushroom powder due to the partial replacement of bread in the composition of minced meat products helps to reduce their energy value. In addition, due to antioxidant properties, the introduction of mushroom powder into minced meat products will inhibit the oxidation of lipids and prolong their shelf life.

References

1. P. Mattila, Nutrition, 16, 694-696 (2000)
2. B.A. Wani, J. Med. Plant Res., 24, 2598-2604 (2010)
3. C. Suresh, Int. J. Agric. Sci., 2, 647-651 (2006)
4. X.M. Wang, Food Chem., 151, 279-285 (2014)
5. M. Friedman, Foods, 5, 2-40 (2016)
6. T. Sawangwan, Agric. Nat. Resour., 52, 519-524 (2018)
7. S. Tinrat, Int. J. Pharm. Sci. Rev. Res., 35, 253-262 (2015)
8. I.A. Kutaia, World J. Pharm. Res., 8, 31-46 (2018)
9. S. E. Mallikarjuna, J. Chem. (2013)
10. M. A. Anandh, Food Sci. Res. J., 11, 17-21 (2020)
11. K. Jo, J. Lee, S. Jung, Korean Food Sci. Anim. Resour., 38, 768-779 (2018)
12. T. Stepanova, N. Kondratjuk, N. Haijuan, Bull. NTU "KhPI", 2, 75-80 (NTU "KhPI", Kharkiv, 2019)