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CHANGES OF SELECTED QUALITY FACTORS DURING PROCESSING AND STORAGE OF "UZICE BEEF PRSHUTA" - TRADITIONAL DRY MEAT PRODUCT

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### INTRODUCTION

Of all the meat products produced in the world today, special importance must be given to the processing of shelf stable dry meat products which rely on traditional procedures for their manufacture. This is particularly true if we take into account their range of usage, the experience acquired so far, as well as their total production rate. To illustrate this, we can state that traditional technologies are used in dry meat products processing on all continents. In addition, shelf-stable dry meat products have been produced in Europe for 250 years, in China for 2000 years and on the island of Cyprus for as long as 3000 years (Incze, 1991). Finally, only in southwestern Spain are one million Iberian hams produced annually (Ventanas *et al.*, 1989), in the area of Mount Zlatibor (Yugoslavia) about 1000t of traditional dry meat products are processed annually (Radovanovic *et al.*, 1990b) and in Brazil the daily production of the traditional product "charque" is between 3 and 30t (Norman and Corte, 1985).

Separate accounts of the problems that relate to the definition of methods of production and of the basic characteristics of dry meat products processed using the traditional technologies in the different parts of the world were given by Leistner (1990) and Incze (1991). Relying on these and other literature data we can state that, in spite of the fact that same basic technological procedures are used in the production process (salting and drying), significant differences are observed in the organoleptical properties of the final products. Above all, this is the result of using different raw materials, of varying origin and degree of grinding. Besides that, NaCl, sugar, nitrates and nitrites, as well as various spices, are added into the raw material, but only NaCl is ubiquitous in the production of the range of products. Finally, special significance in the formation of specific sensory characteristics of the traditional meat products is placed upon the environmental conditions that exist during processing (e.g., temperature and the relative air humidity), which mostly depend upon the climatic characteristics of the area in which the products are processed. Bearing in mind that shelf stable dry meat products processed by the traditional technologies greatly differ in terms of their means of production and their organoleptical properties, it is therefore suggested that products should be classified according to their water activity value ( $A_w$ ) and their pH value. According to the  $A_w$  value, shelf-stable dry meat products are divided into fermented or high moisture products ( $A_w > 0.9$ ), intermediate moisture products ( $A_w = 0.6-0.9$ ) and low moisture products ( $A_w < 0.6$ ) -- Leistner (1990). According to their pH value, products with low acid content ( $pH > 5$ ) are distinguished from products having a high acid content ( $pH < 5.5$ ) -- Incze (1991).

"Uzice beef prshuta", which is the subject of this study, is one of the shelf stable dry meat products that is traditionally processed in the area of Mount Zlatibor, in southwestern Serbia (Yugoslavia) during the winter months (November - February). The technological procedures for manufacturing "Uzice beef prshuta" is described in detail in previous research papers (Radovanovic *et al.*, 1990a; 1990b). Here we are giving only the most important characteristics of the process.

Selected and carefully shaped muscle groups obtained from beef carcasses, which weigh approximately two to seven kilograms, are salted at a temperature of about 5°C over a five to seven day period. Only pure NaCl is used, at a level

of about 3% of the meat mass. Desalting, which lasts 12 hours, is performed by submerging the salted meat into tubs with continually circulating water. After that, the meat is hung by a thin rope, pulled through one of the products ends upon sticks placed in the frames, and then allowed to drain over a 12 hour period at a temperature of approximately 5°C. Drying is performed in four to five meter-high wooden chambers with a fire-box, at a temperature of 8-10°C (max. 12°C) and relative air humidity of 70-75%. During the process of drying, which usually lasts three to four weeks, the product loses around 40-50% of its original weight by evaporation. Over this period, the product is smoked for five to seven days using a specified frequency which drops with time. Eventually, the final product contains 4-5% NaCl, and the quantity of water, proteins, fats varies depending upon the quality of the raw material.

In view of the limited data obtained from the literature it is apparent that the quality factors in "Uzice beef prshuta", and their changes over the course of the production process, are yet to be completely determined. Here we refer above all, to the indicators of the chemical composition, the Aw and pH values, as well as to the colour, rheological properties, quantity of the soluble and amino acid nitrogen contents, amino-acid and fat-acid compositions, chemical structures of the protein and lipid macromolecules and so on.

In accordance with the facts, mentioned above, it was decided that the definition of changes in the quality factors of "Uzice beef prshuta" during its production, in our long-term research should be included. In this respect, this paper treats only the problems relating to the changes in the basic chemical composition, Aw and pH value in the products made in the production facilities of IM "Cajetina" on Mount Zlatibor.

## MATERIALS AND METHODS

In this study two different commercial parts of meat obtained from beef round ("sol" - *m.gracilis* with part of *m.semimembranosus*) and loin ("rozbratna" - *m.longissimus thoracis*) were used. These which have previously stored in a frozen state for three to four months. After defrosting, 60 pieces of "sol" and 60 pieces of "rozbratna" were formed in the shape of prshuta with average weights of 1.48kg (Cv=10.14%) and 1.68kg (Cv=16.09%) respectively.

Within each of the two examined parts of the muscle, eight experimental groups were formed, each containing six prshutas. Experimental groups were respectively analyzed in each of the eight observed processing phases. Of the remaining 12 prshutas, weight measurements were made.

Processing of "Uzice beef prshuta" was accomplished using traditional technology (Radovanovic *et al.*, 1990b). The measurements of quality factors were made during the observed processing phases, defined as follows:

- phase I - immediately before salting;
- phase II and III - 3rd and 7th (the last) day of salting;
- phase IV, V and VI - 7th, 14th and 21st (the last) day of drying and smoking;
- phase VII and VIII - 15th and 30th day of storage.

Weight loss determinations were made by measuring the weight of the prshutas in all of the phases mentioned above.

pH values were measured using a model "MA - 5735" pH-meter, with meat:water ratio of 1:5.

The "Novasina TH - 2" model instrument was used for determining Aw.

The proximate chemical composition (moisture, proteins, fats, minerals and NaCl) was determined according to official AOAC methodologies (AOAC, 1980).

At the end, experimental results were graphically illustrated by presenting the mean values (n=6) of every observed quality factor and every processing phase.

## RESULTS AND DISCUSSION

The observed weight loss in "Uzice beef prshuta" during the production and storage phases is presented in Figure 1. Total average weight loss during the observed 58 days was 60.20% for "sol" and 53.81% for "rozbratna". It was found that product loses in the amount of 2.65% for "sol" and 4.04% for "rozbratna" during the salting process (first seven days). In the course of drying and smoking (from 7th to 28th day) "sol" loses an additional 50.82%, and "rozbratna" an additional 40.55%. Finally, in the observed storage process (from 28th to 58th day) the "sol's" and "rozbratna's" respective weights dropped by 6.73% and 9.22%.

The maximum loss of mass for both muscle groups used in the production of prshuta was determined for the second week of the production process, which corresponds to the first seven day period of drying. In this interval the average weight loss increases by 30.35% for sol and by 24.96% for rozbratna. Minimal mass variations were observed during the first three days of salting. In this period the mass of the product decreased by only 0.75% for sol, and by 1.76% for rozbratna.

Data obtained for percentage moisture content changes during the processing and storage of prshuta are given in Figure 2. Before salting (phase I) the average moisture content in "sol" was 74.88%, and 66.01% in "rozbratna". After salting (phase III) the water content dropped, with mean values of 68.44% and 60.87% for "sol" and "rozbratna" respectively. Drying drastically reduced the water content of the product, and the final products (phase VI) contained 41.06% and 40.09% of water respectively. After 30 days of storage (phase VIII), the average water content was 30.19% in sol and 30.68% in rozbratna.

In comparing the average water contents of the products, it was observed that the intensity of water evaporation was higher in sol than in rozbratna, in all production phases. This is understandable if we consider the fact that immediately before salting "sol" had a smaller average weight (1.48kg) and a higher moisture content (74.88%) than rozbratna (1.68kg; 66.01).

Variations in the total protein content during the processing and storage of "Uzice beef prshuta" are given in Figure 3. In both muscle groups the quantity of protein increased proportionately to the increase of the dry matter amount, and the differences in the total protein content between sol and rozbratna increased. While the difference between the average protein content in sol (20.95%) and rozbratna (20.05%) prior to salting was small, and came to 4.3 index percent, the final (after drying) protein content in "sol" (47.18%) was about 19.2 index percent higher than in the "rozbratna" (38.12%).

A similar tendency may be noted within the variations of total fat content (Figure 4). The original fat content (2.48% - "sol"; 11.99% - "rozbratna") increased proportionately with the increase in dry matter amount, and in the final product it came to 5.22% for sol and 15.95% for rozbratna. However, unlike the protein content, the fat content was higher in rozbratna and about 4.83 times higher in phase I and 3.06 times higher in phase VI.

Changes in mineral (ash) and NaCl content over the course of "Uzice beef prshuta" processing is shown in Figures 5 and 6. It is striking to note these quality factors vary in an identical manner. This can be explained by the fact that NaCl is, in the aspect of quantity, the dominant mineral component in the dry meat products. The concentration of NaCl in both observed muscle groups significantly grows during salting, and it is noted that the intensity of the NaCl penetration is higher in smaller pieces of meat having a higher water content sol than in bigger pieces having a lower water content ("rozbratna"). Thus, after three days of salting the average NaCl concentration was 4.04% in sol, and 2.78% in "rozbratna". Still, in the period between the third and seventh day of salting the concentration of NaCl in "rozbratna" intensified, and therefore upon completion of the salting process the table salt content was 5.80% in sol, and 5.02% in "rozbratna".

After the first week of drying and smoking the decrease in the average NaCl content was detected in both muscle groups (3.91%; 3.29%). This was obviously caused by desalting, which is usual or common procedure in the processing of "Uzice beef prshuta".

In the results presented in Figure 7 it may be observed that the water activity values in both muscle groups varied proportionately with the total water content, which changed during processing and storage, as discussed above. Moreover, the maximum average  $A_w$  value (0.984 - sol; 0.982 - rozbratna) was determined in the first observed phase (immediately before salting) and the lowest one (0.698; 0.718) in the eighth phase (after 30 days of storage). After drying and smoking, the average  $A_w$  value in the final product was 0.774 in sol, and 0.771 in rozbratna.

Finally, data relating to changes in the pH value during the production and storage of prshuta are presented in Figure 8. It is obvious that there are no intensive changes in the pH values of any of the observed muscle groups. In "rozbratna" pH varies between 5.88 (phase I) and 5.43 (phase VI), and in "sol" from 5.62 (phase I) to 5.45 (phase VI). On the one hand, the pH value decreases during the production process, while on the other hand it increases during storage. The only exception to this tendency was determined for "sol" in the processing phase IV of when the pH value was a maximum (5.69).

## CONCLUSIONS

On the basis of the research results the following conclusions should be emphasized:

During the processing of "Uzice beef prshuta" in the production facilities of IM "Cajetina" (Zlatibor), the average weight loss was 53.47% for sol and 44.59% for rozbratna. After 30 days of storage, the weight of the products decreased, on average, an additional 6.73% for sol and 9.22% for rozbratna.

After 7 days of salting the compositions included 68.44% water, 21.89% proteins, 2.84% fats and 5.80% NaCl in sol, and 60.87% water, 20.38% proteins, 12.38 fats and 5.02% NaCl in rozbratna.

After 7 days of salting and 21 days of drying and smoking, the final product contained 41.06% water, 47.18% proteins, 5.22% fats and 4.96% NaCl in sol, and 40.09% water, 38.12% proteins, 15.95% fats and 4.26% NaCl in rozbratna.

Considering the water activity value in the final product ( $A_w=0.772-0.774$ ), "Uzice beef prshuta" is an intermediate moisture meat product, and according to the final pH value (5.43-5.45), this traditional meat specialty should be included in the group of meat products with high acid content ( $pH>5.5$ ).

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