

THE EFFECT OF BRINE PRESERVATION ON MUSHROOMS

Cornelia Lungu, Octavian Baston*, Eugenia Mihaela Pricop
Dunarea de Jos University of Galati, 111, Domnească Street, 800201, Galati, Romania.
E-mail: octavian.baston@ugal.ro

Abstract

Mushrooms were minimally processed using blanching, preserved in 1.5 %, 2.0 % and 2.5 % sodium chloride solutions and then stored for a week at room temperature. The two mushroom species were physicochemical and sensorial analyzed. Results showed that dry weight, reducing sugars, total protein, ascorbic acid and niacin amount of mushrooms decreased significantly ($P < 0.05$) after one week storage in brine. The losses of the reducing sugars in 2.5 % brine for *Agaricus* were of 20%, and for *Pleurotus* of 11 %. The preservation in a brine concentration of 2.5 % leads to the highest decrease in total protein amount for both species of mushrooms. Ascorbic acid decreased for *Agaricus* by 22 % and for *Pleurotus* by 28 % when stored in 2.5% brine for one week. The greatest loss of niacin occurred for the 2.5 % brine concentration. Compared with the control sample, niacin in *Agaricus* decreased by 3.5 % and in *Pleurotus* by 4%. The most important loss of nutrients occurred for 2.5 % brine for both mushrooms species. In the case of sensorial analysis the results showed that the assessors were pleasantly impressed by the mushrooms preserved for one week in 2.5% brine. Therefore the smell, taste, firmness and appearance of the processed mushrooms received the highest points. The mushrooms preserved in 1.5 % brine were characterized by the panelists as being close to the beginning of alteration.

Keywords: *Agaricus bisporus*, *Pleurotus ostreatus*, hurdle, minimal processing.

Submitted: 29.07.2015

Reviewed: 15.10.2015

Accepted: 8.12.2015

1. INTRODUCTION

Brine preservation of vegetables has been used since ancient times, when the options to keep food unaltered more time were limited. This process should not be confused with pickling, which is produced by adding small amounts of salt, which serves to the stimulation of lactic fermentation and is not itself a mean of preservation. For microorganism destruction, the brining of mushrooms can be followed by canning (Vivar-Quintana *et al.*, 1999).

Depending on the salt concentration in the brine, the mushrooms can be preserved in two ways. One way is heavy brining by immersion of the mushrooms in a concentrated solution of brine. The mushrooms are immersed in 22 to 25 % sodium chloride (NaCl) concentration and kept for two to six weeks at a minimum concentration of 20 % NaCl. Also, the brine pH is lowered to 3.5 with the help of acid solution (Miles and Chang, 2004). No heat treatment is needed. So, in this case, the microorganisms are facing two hurdles: the acid medium and the salt concentration. The other way is light brining, using brine concentration up to 5% NaCl and heat treatment. It consists in

immersing the mushrooms in a light acidified solution of brine that contains 2% sodium chloride, followed by sterilization (Chandrasekar *et al.*, 2004). The two hurdles present here are: the heat and the salt concentration. Another method of mushroom preservation is by steeping them in chemical mixtures solution that contains various amounts of sodium chloride. The mixtures can contain salt (sodium chloride), citric acid, sodium bicarbonate and potassium metabisulphite (Kapoor, 1989) or salt, sugar, citric acid, potassium metabisulphite and ascorbic acid (Singh *et al.*, 1995).

This is a chemical preservation of mushrooms and, according to the above mentioned authors; the concentrations of each chemical do not exceed 5%. The purpose of this paper is to determine the variation of some physicochemical parameters of mushrooms at various brine concentrations and the acceptability of the preserved mushrooms.

1. MATERIALS AND METHODS

Materials

The studied mushrooms are *Agaricus bisporus* and *Pleurotus ostreatus* that were bought from

a local market in refrigerated state and packaged in plastic trays. They were processed by washing in cold water, blanching in hot water at 95 to 99 °C for 5 minutes, cooling in water at 15 °C, water draining with a strainer, cutting into slices of 30 mm x 30 mm for *Pleurotus* and 5 mm thick for *Agaricus*. A slicer (KuchenProfi, Germany) was used for cutting the *Agaricus* mushrooms. Preservation in brine was performed using sodium chloride solution (made from mined, unrefined salt) at 1.5 %, 2.0 % and 2.5 % concentrations. The brine concentrations were prepared by dissolving salt in water, boiling for 15 minutes at 95 to 99 °C, cooling at 20 to 23 °C, decanting and filtering. The mushrooms and brine were put into glass jars of 370 ml and sealed. They were kept in a dark room for one week at 20 to 22 °C and then analyzed.

Physicochemical evaluation

Fresh and blanched samples of the two species of mushrooms were subjected to physicochemical analyses. According to AOAC (1995) methods, the moisture was determined at 105°C using ITM 50 oven (Bucuresti, Romania) and the total protein was determined using UDK 130 D distilling unit (Velp Scientifica, Italy). The reducing sugars were determined by the Luff-Schoorl titrimetric method (CE, 2009). Using the iodometric method described by Suntornsuk *et al.* (2002) the ascorbic acid was determined. Niacin was determined at 436 nm by the AOAC (1995) 961.14 method using the DR/2010 spectrophotometer (Hach, U.S.A.). All chemical data were calculated on a dry basis.

Sensorial evaluation

For the sensorial analysis of the brined mushrooms it was used the Romanian standard (SR EN ISO 13299:2010). According to Baston *et al.* (2014) the sensorial attributes and the quality of preserved mushrooms in brine were evaluated.

Statistical analysis

The statistical analysis was performed by using Microsoft Excel 2010 for the determination of mean, standard deviations and the ANOVA

linear regression analysis between sodium chloride concentrations and the chemical parameters analyzed. The statistical significance was $P < 0.05$. For physicochemical determinations and for sensorial evaluation three determinations for each analyzed parameter ($n=3$) were performed.

2. RESULTS AND DISCUSSION

In figure 1 the dry weight variations of mushrooms immersed in the three brines concentrations were determined after one week of storage. The brine concentration of 0 % is the control sample and refers to the mushrooms that were blanched and analyzed before being brined.

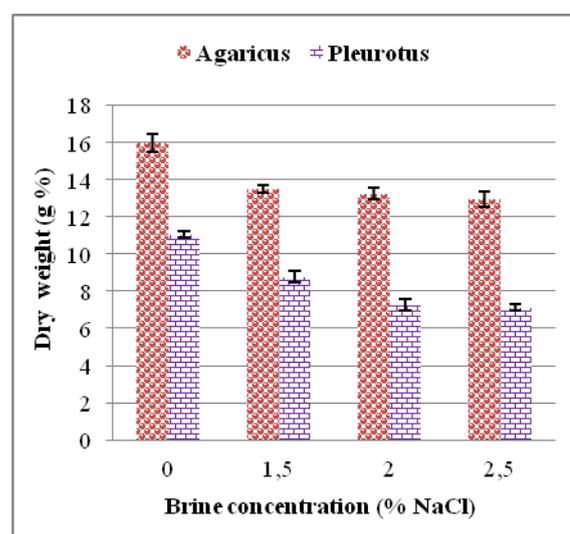


Fig. 1. The variation dry weight function of brine concentration

The variation of mushrooms dry weight function of brine concentrations is important for our study because we want to know what losses can occur by solubilization of the mushroom components into the brine. The dry weight of both species of mushrooms decreased significantly ($P < 0.05$) with the increasing of brine concentration in sodium chloride. For the brine concentration of 2.5 % the highest losses were determined. After one week storage in brine, *Pleurotus* presented 35 % losses whereas *Agaricus* only 19 %. Satinover and Marinescu (1962) explain those losses by brine solubilisation of substances (sugars, minerals, hydrosoluble proteins and vitamins etc.).

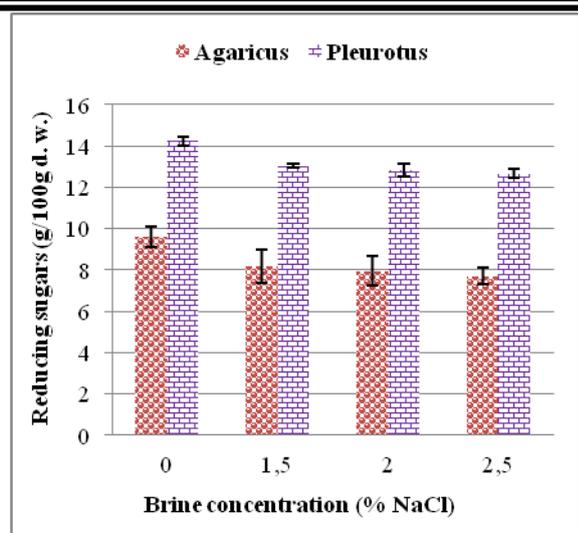


Fig. 2. The effect of brine concentration on reducing sugars content

From the data presented in figure 2, the reducing sugar content of the mushrooms decreased significantly ($p < 0.05$) with the increasing of brine concentration. When compared with the control sample, the lowest amounts of reducing sugars were determined at 2.5 % sodium chloride for both species of mushrooms. The losses of the reducing sugars in 2.5 % brine for *Agaricus* were of 20%, and for *Pleurotus* of 11 %. It seems that the concentration of 2.5 % NaCl increased the diffusion in brine of the reducing sugars. Bernas *et al.* (2006) reported a decrease between 12 and 29 % in total sugars for *Agaricus*.

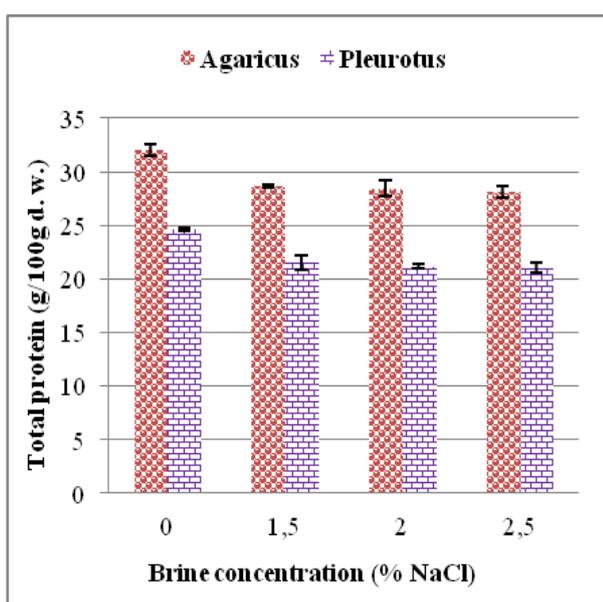


Fig. 3. The effect of brine concentration on total protein amount of mushrooms

In figure 3 it can be seen that the total protein amount of mushrooms is decreasing with the increase of brine concentration. The decreasing in total protein for both mushrooms species is significant ($p < 0.05$). The preservation in a brine concentration of 2.5 % leads to the highest decrease in total protein amount for both species of mushrooms. Bernas *et al.* (2006) reported that brine preserved *Agaricus bisporus* had a decrease in total nitrogen from 24 % to 29 %. We determined a decrease in the total protein content of 12 % for *Agaricus* and of 14 % for *Pleurotus*. This decrease is due to the fact that some of the hydrosoluble proteins from the mushrooms pass into the brine (Satinover and Marinescu, 1962).

Two hydrosoluble vitamins were studied: ascorbic acid and niacin. Figure 4 presents the changes that occurred for the ascorbic acid.

With the increase of the brine concentration, the ascorbic acid amount is significantly ($p < 0.05$) decreasing. Compared with the control sample, the mushrooms preserved in 2.5 % brine presented the lowest content in ascorbic acid. Thus, ascorbic acid decreased for *Agaricus* by 22 % and for *Pleurotus* by 28 %. This decrease is due to the fact that the ascorbic acid diffused in brine and suffered oxidations (Satinover and Marinescu, 1962), because it is a highly water-soluble vitamin (Rickman *et al.*, 2007).

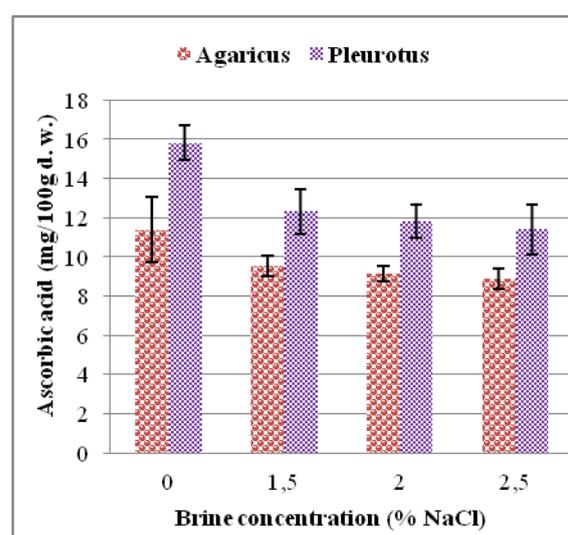


Fig. 4. Ascorbic acid changes function of brine concentrations

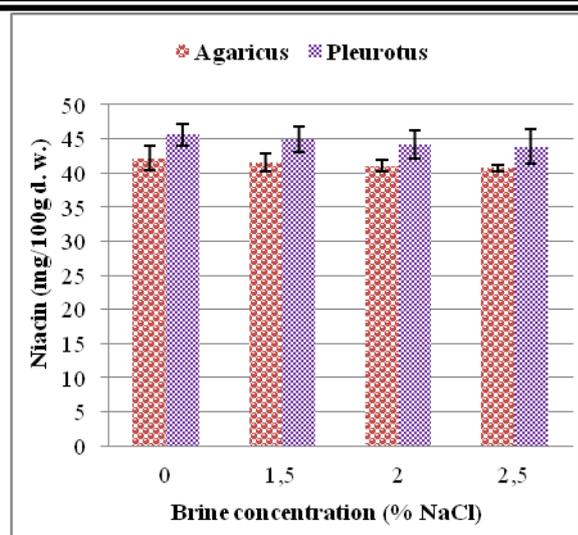


Fig. 5. Niacin changes in various brine concentrations

According to figure 5, niacin is decreasing significantly ($p < 0.05$) at studied brine concentrations. *Agaricus* and *Pleurotus* lost some niacin at brine preservation for one week. The greatest loss of niacin occurred for the 2.5 % brine concentration. Thus, niacin in *Agaricus* decreased by 3.5 % and in *Pleurotus* by 4%, compared with the control sample. This is due to the fact that niacin is a hydrosoluble vitamin, and it passed in brine (Satinover and Marinescu, 1962) and is stable in case of processing (Rickman *et al.*, 2007). In the figures 6, 7 and 8 the sensorial analysis of mushrooms for 1.5 %, 2 % and 2.5 % brine concentrations are presented.

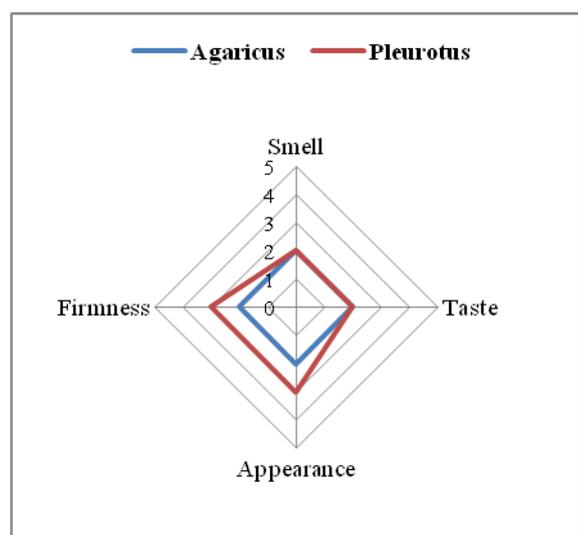


Fig. 6. Sensorial analysis of the mushrooms preserved in 1.5 % brine

After one week of brine preservation at room temperature, according to figure 6, all the analyzed attributes have low values, especially the smell and the taste. Also, the firmness and appearance were not very well accepted by the assessors. *Pleurotus* presented a better firmness and appearance than *Agaricus*.

It appears that the brine concentration of 1.5 % had no effect on improving the taste and firmness of the mushrooms. By the given scores, the panelists characterized the mushrooms as being at the beginning of alteration.

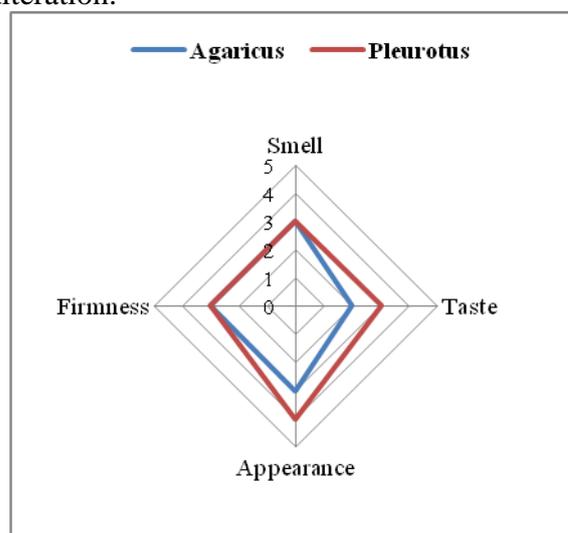


Fig. 7. Sensorial analysis of mushrooms preserved in 2.0 % brine

A 2.0 % brine concentration improved the sensorial characteristics of the mushrooms preserved in 1.5 % brine. An increased concentration of 0.5 % sodium chloride led to the improvement of sensorial attributes of mushrooms. As presented in figure 7, for *Agaricus*, the smell, firmness and appearance were increased by one point as compared with the attributes presented in figure 6. The taste of the mushroom wasn't changed. It seems that a 0.5 % increase in salt concentration of brine could not be detected by the assessors for changing the score. In the case of *Pleurotus* only firmness had the same score as the one in figure 6. The other three attributes improved by one point, resulting in better product acceptability. It seems that an increase in the salt amount of 0.5 % protects the brined mushrooms from alteration and improves the acceptability.

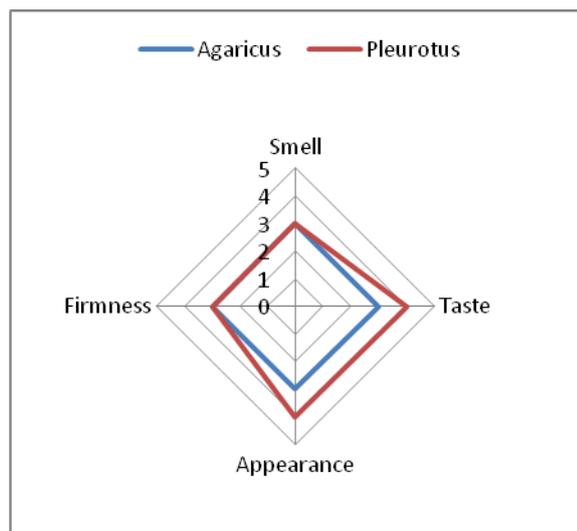


Fig. 8. Sensorial analysis of mushrooms preserved in 2.5 % brine

Mushrooms that were preserved in 2.5 % brine, as compared with data presented in figure 7, improved only in taste. Both *Pleurotus* and *Agaricus* presented an improvement in salt taste due to the increase in the salt content of the brine. In this case it seems that the osmotic transfer of the sodium chloride from brine to mushrooms could be detected by the assessors, thus leading to product salting and taste improving. The 0.5 % increase in the salt concentration of the brine had no effect on the smell, on the appearance or on the firmness of the preserved mushrooms.

3. CONCLUSIONS

The minimal processing (one week in low concentrated brine, at room temperature) of mushrooms leads to nutrients losses. Compared with the 1.5 % and 2.0 % brine concentrations, the studied physicochemical parameters presented higher losses at 2.5 % brine, but the sensory attributes for this brine concentration were better.

4. REFERENCES

[1] Vivar-Quintana, A. M., González-San José, M. L. and Collado-Fernández, M. Influence of canning process on colour, weight and grade of

mushrooms. *Food Chemistry*, **66**(1), 1999, 87-92.

- [2] MILES, P. G. and CHANG, S. T. *Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact*. CRC press, 2004, p. 321.
- [3] Chandrasekar, V., Gopal, T. K. and Rai, R. D. Heat penetration characteristics and shelf-life studies of mushrooms in brine processed in retort pouches. *Packaging Technology and Science*, **17**(4), 2004, 213-217.
- [4] KAPOOR, J.N. *Mushroom Cultivation*. ICAR, New Delhi, 1989, p. 15.
- [5] Singh, S., Kumar, C. G. and Singh, S. Production, processing and consumption patterns of mushrooms. *Indian Food Industry*, **14**, 1995, 38-47.
- [6] AOAC. Association of Official Analytical Chemists. Official method of analysis. 16th ed., Washington, DC, USA, 1995.
- [7] CE 2009. Commission Regulation no. 152, laying down the methods of sampling and analysis for the official control of feed. Determination of reducing sugars, 2009, 54-57.
- [8] Suntornsuk, L., Gritsanapun, W., Nilkamhank, S. and Paochom, A. Quantitation of vitamin C content in herbal juice using direct titration. *Journal of pharmaceutical and biomedical analysis*, **28**(5), 2002, 849-855.
- [9] SR EN ISO 13299:2010. Sensory analysis methodology. General guidance for establishing a sensory profile, 2010.
- [10] Baston, O., Pricop, E.M. and Lungu, C. The influence of frozen storage on some commercial mushrooms. *Food and Environment Safety*, **13**(4), 2014, 321-326.
- [11] Satinover, N. and Marinescu, I. *Conservarea industrială a alimentelor. (Industrial food preservation)*. Editura Tehnică, București, 1962, p. 116.
- [12] Bernaś, E., Jaworska, G. and Kmiecik, W. Storage and processing of edible mushrooms. *Acta Scientiarum Polonorum Technologia Alimentaria*, **5**, 2006, 5-23.
- [13] Rickman, J. C., Barrett, D. M. and Bruhn, C. M. Nutritional comparison of fresh, frozen and canned fruits and vegetables. Part 1. Vitamins C and B and phenolic compounds. *Journal of the Science of Food and Agriculture*, **87**(6), 2007, 930-944.