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THE MOST EFFICIENT PROCESSING METHODS FOR RETAINING THE MEDICAL PROPERTIES OF *TAM JALAPENO* CHILI PEPPERS

BY

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Abstract. This study aims to establish the best processing methods for chili pepper, Tam Jalapeno variety that maintains its medicinal properties. Chili pepper has been processed by irradiation, dehydration, freezing, preservation as jam and maceration in vinegar, oil and brine. The medicinal properties of chili pepper were analysed for vitamin C content, Scoville hot scale and qualitative analysis of capsaicin by thin layer chromatography (TLC). Experimental data shows that the most effective methods for conservation that maintains its medicinal properties are: dehydration, preservation in brine, maceration in oil and as jam.

Keywords: chilli; maceration; irradiation; dehydration.

1. Introduction

The Tam Jalapeno peppers belong to the Jalapeno family, which have a cylindrical fruit with specific striations, a slightly rounded tip, and red when matured. They have a medium hotness value of 2500-8000 degrees Scoville and

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are very flavored. They can easily adapt to all kind of environment, so in Romania there are large crops of hot peppers (Bojor and Perianu, 2005). The bioactive ingredient in chili pepper is capsaicin, that induce the spicy taste. Hot chili peppers also contains vitamin C, vitamin complex B, vitamin A, vitamin K, fibers, folic acid and flavonoids, such as: β-carotene, α-carotene, zeaxanthin and cryptoxanthin that protect the human body from the harmful effects of free radicals generated by stress and other conditions. Also, red chili pepper contains a substance called lycopene that reduces the risk of certain types of cancer (Basu and De, 2003).

Chili peppers can be processed by many methods, such as: dehydration, freezing, oil and vinegar maceration, sugar preservation, etc. (Beceanu and Chira, 2003). These methods can be applied both industrially or in households. Generally, industrial processing involves obtaining preserved products with similar chemical compositions and higher energy value than the raw materials from which they are obtained. Unfortunatelly, in most cases, the processed products lose the medicinal and nutritive properties of the raw materials.

Considering these aspects, the main objective of the paper is to highlight the best methods of preserving Tam Jalapero chili peppers so that it retains its bioactive properties. So, chili peppers were processed by: dehydration, freezing, jam, oil and vinegar maceration. The analyzed properties of chili were: Scoville value, vitamin C content and qualitative analysis of capsaicin by thin layer chromatography (TLC).

2. Experimental

Tam Jalapeno chili peppers used in this study were buyed from a local farmer in Iasi. The auxiliary materials needed for maceration (vinegar, olive oil and salt) and preserving as jam (sugar) were purchased from the supermarket. All reagents required for analysis (vitamin C and TLC) were from Merck.

For processing, the chili peppers have first been cleaned of dust, soil, etc., washed several times, and then dried. So prepared, the peppers were processed according to the literature (Georgescu, 2014) as follows:

- Irradiation. Hot peppers were exposed to ionizing radiation emitted by artificial 137Cs radioisotope in a 400840 Paprika Irradiation equipment. The radiation dose was 150 Gy for 22 days.
- Dehydration. Chili peppers were dehydrated for 2-3 weeks by sun exposure, then they were stored in paper bags in a dry place.
- Freezing. Peppers were first bleached for few seconds, then frozen at T=-18°C, for 2-3 months, and stored at low temperatures.
- Maceration in vinegar. Fresh whole green and red peppers were placed in a sterilized glass container, and then the maceration solution was added in a 1:2 ratio. The solution was made from wine vinegar, salt and sugar, and before being added to the jar of peppers, it was heated to boiling. The maceration was

carried out at room temperature for 3 months, after which the mixture was filtered and the obtained extract was kept in a clean, airy and cool space for analysis.

- Maceration in oil. Chili peppers were cut into halves and placed in sterilized glass containers, then olive oil was added in a 1:2 ratio. The maceration was carried out at room temperature for 3 months, then the mixture was filtered and the obtained extract was kept in a clean, airy and cool space for analysis.
- Maceration in brine. To obtain products preserved in brine, the fresh fresh peppers were placed in sealed glass containers and a 1:2 ratio solution of brine was added. The maceration was carried out at room temperature for 3 months, then the mixture was filtered and the obtained extract was kept in a clean, airy and cool space for analysis.
- As jam. Chili peppers were chopped into a blender and then transferred in a clean and dry metallic container. A syrup obtained from vinegar and sugar was added to the product in the container in a 1:2 weight ratio, after which the mixture was boiled for 20 min stirring from time to time. Finally, the hot product was transfered in clean, dry, and sterilized glass containers and then sealed. After cooling to room temperature, the containers were stored in a clean and well-ventilated area for 2-3 months.

In order to obtain the acetone extract of hot peppers, the following stept were carried out: in a Erlemneyer flask a certain amount of the previously-shredded sample was introduced, then the acetone was added in a ratio of 1:15. The mixture was left at room temperature for 2 h, stirring periodically. At the end of the extraction time, the mixture was filtered and the residue was washed 3-4 times with 5 mL acetone (Cernătescu and Cobzaru, 2014).

For the sensory analysis of capsaicin in the preserved product, 5 volunteers aged 20-25 years were selected. The hotness degree was measured in Scoville units as follows: 5 test tubes were labeled with: 1:10; 1:100; 1:1000; 1:10,000; 1:100000, and a specific volume of 5% sugar solution was introduced into each tube (9 mL). A certain amount of product was shredded in the mortar and then 95% ethyl alcohol was added, grinding with the pestle. From the homogeneous and clear mixture, a well-established sample volume (1 mL) was measured using a clean pipette and inserted into the first tube, the one marked 1:10. The tube was covered with a stopper and then shaken very well, and then another clear pipette was used to measure 1 mL mixture, same as in the previous case and placed in a 1:100 labeled tube, covered with a stopper and agitate very well. The same procedure was applied to the rest of the tubes labeled with 1:1,000, 1:10,000 and 1:100,000, respectively, as well as covering with a stopper and shaking very well. From the test tube 1:100,000 a sample was taken with a clean pipette and one drop was added into 5 teaspoons of plastic. Each volunteer received one teaspoon of sample, and if they did not feel the hot taste, the experiment was repeated using the test tube marked 1:10,000.

If volunteers did not feel the hot taste, the experiment was repeated until the first test tube at 1:10 was reached. The test was repeated until 3 of the 5 volunteers felt the hot taste of the analyzed sample, the number inscribed on the last test tube, representing the value of the Scoville units that the pepper has. All samples were tested at room temperature (Cernătescu and Cobzaru, 2014).

For the determination of vitamin C in the extracts, the iodometric method described in the literature was chosen (Cobzaru and Horoba, 2011). Thus, a certain amount of extract was introduced into a 100 mL flask and then completed up to the mark with a starch/HCl solution. A well-determined sample volume of the vial was taken and titrated with a 0.01 N iodine solution until the blue staining that had occurred persisted for a few seconds. The titration was repeated two more times, at the end of which the arithmetic mean was obtained between the three values measured from titrations.

Vitamin C content in 100 g of product is given by:

vit.C = 1.321 x 104 (VI/MP) mg /100g raw material

where: VI - volume of iodine, 0.01 N solution, used for titration,

MP - the amount of raw material used in extraction, g.

In order to obtain the sample to be analyzed, a certain amount of preserved product was grounded into a mortar and then transferred into a 250 mL Erlenmeyer flask, followed by the addition of a 2% HCl solution. The contents of the vial were agitated for 30 min, and finally the mixture was filtered, the residue was washed with 2% HCl. The obtained extract was transferred into a 150 mL flask and then filled with a 2% HCl solution up to the mark.

Identification of capsaicin from the concentrated extracts of preserved chili pepper by thin layer chromatography (TLC) was performed according to the literature (Cernătescu and Cobzaru, 2014).

In order to view more easily the results of the experimental data, in Table 1 the notations made for the samples to be analyzed are presented.

Table 1
The Notations for the Samples to be Analyzed

Sample	Notations
Concentrated extract from fresh chili	AP
Concentrated extract from dried chili	AU
Concentrated extract from irradiated chili	AI
Concentrated extract from chili conservated in brie	AS
Concentrated extract from frozen chili	AC
Concentrated extract from chili in vinegar	AO
Concentrated extract from chili in oil	AUL
Concentrated extract from chili jam	AD
Concentrated extract from chili in ehtanol	AET

3. Results and Discussions

3.1. Extraction of Capsaicin from the Preserved Chili Pepper Samples

Fig. 1 shows the calculated yields for concentrated extracts of preserved chili pepper.

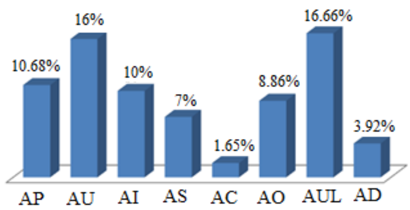

Fig. 1 – Graphical representation of calculated yields for the concentrated extracts of preserved chili pepper samples.

From the experimental data presented in Fig. 1, it can be seen that good yields were obtained when extracting capsaicin, except for the frozen chili pepper (1.65%) and the preserved as jam (3.92%).

Since the yield calculated for the concentrate acetone extract from dried hot pepper is high, the concentration of an ethanolic extract from dry chili peppers was made for comparison. This was done because in food it is allowed to use an alcoholic extract of hot chili and not an acetonic one. In order to obtain the concentrated alcoholic extract from peppers, a mixture of dried chili and 96% fermentation alcohol was used in a ratio of 1:5, macerated for 7 days and then concentrated by rotavapor. Finally, the yield calculated for the concentrated alcoholic extract was 15.22%. This demonstrates that, when using alcohol extract of chili peppers, it is possible to make a maceration of the hot pepper in alcohol and then concentrate it, the final product being more concentrated in carotenoids (red purple color).

3.2. Sensory Analysis of Capsaicin

Fig. 2 shows graphically the hotness of various pepper samples.

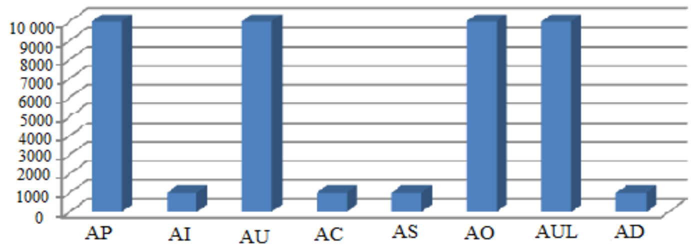

Fig. 2 – The hotness of the pepper samples.

From Fig. 2 it can be noticed that in the case of peppers fresh, dry and preserved in both vinegar and oil, the value of the degree of hotness falls within the range of 2500-8000 Scoville units, corresponding to the literature data (Cernătescu and Cobzaru, 2014) for paprika Tam Jalapeno. Also, the hotness for these samples is much higher than that of pepper irradiated, frozen, preserved in brine or as jam. This can be explained by the fact that dehydration and maceration processes do not affect capsaicin. Moreover, drying removes the water from the pepper composition, making it more concentrated and hot, and by maceration some of the capsaicin is also stored in the maceration liquid.

Peppers preserved by irradiation, freezing, in brine or as jam have extremely low degrees of hotness compared to other samples. In these cases, it can be said that radiation, temperature drops as well as fermentation could be the main factors that have a negative effect on capsaicin.

3.3. Determination of Vitamin C Content from Preserved Hot Pepper Samples

Fig. 3 presents graphically the vitamin C content of the analyzed samples.

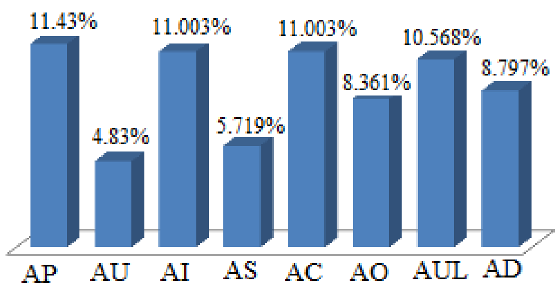

Fig. 3 – Vitamin C content of the analyzed samples.

As can be seen from Fig. 3, there are significant variations in vitamin C content in the analyzed samples, depending on the applied conservation method. Considering the conservation effect on vitamin C content, preservation by dehydration, brine and maceration in oil are methods that do not destroy the vitamin C, keeping it in optimal parameters and being very close to that from fresh pepper.

Conservation in vinegar or as jam gives satisfactory results in terms of vitamin C content compared to fresh paprika. However, in these cases, the loss of vitamin C may be due to preliminary preparations, for example, hot peppers have suffered mechanical damage by shredding.

The largest damages to vitamin C were recorded both in frozen pepper and in those preserved by ionizing radiation. Conservation of hot pepper with radiation confirms literature data (Broda and Schonfeld, 1959), according to which the radiation has a negative effect on both vitamin C and other nutrients present in the plant product. Also, in the case of frozen fruits and vegetables, the losses of nutrients occur slowly but surely.

3.4. Identification of Capsaicin from Hot Chili Concentrate Extracts Preserved by thin Layer Chromatography (TLC)

Table 2 shows the values calculated for all hot pepper extracts.

Table 2
Rf Values Calculated for all Hot Pepper Extracts

Sample	R_{f1}	R_{f2}	R_{f3}	R_{f4}
AP	0.3	0.5	–	–
AU	0.3	0.6	0.7	0.9
AI	0.3	0.7	0.9	–
AS	0.3	0.5	0,7	0.8
AC	0.4	0.7	0.9	-
AO	0.25	0.4	0.8	0.9
AUL	0.8	–	–	–
AD	0.29	0.5	–	–
AET	0.3	0.5	0.8	–

The experimental data presented in Table 2 shows that the $R_{f3} \cong 0.25\text{-}0.3$ value is found in all the concentrated extracts, except those of preserved pepper, oil-cured and jam. According to the literature (Cernătescu and Cobzaru, 2014) this value corresponds to capsaicin and dihydrocapsaicin, bioactive compounds present in hot chili.

In case of concentrated extract from chili macerated in oil, vinegar and brine, the presence of the retention factor at 0.8 confirms that carotenoids are found in these samples, as mentioned in the literature (Cernătescu and Cobzaru, 2014). It is also noteworthy that capsaicin and carotenoids are present in the concentrated ethanol extract, which is confirmed by the retention factor value of 0.3 and 0.8, respectively.

Although it has a red coloration, the presence of carotenoids or capsaicin and dihydrocapsaicin has not been confirmed in the concentrated extracts from frozen hot peppers. This confirms once again that high or low temperature can affect the active compound in the plant material composition.

4. Conclusions

This study highlights the best method for preserving chili peppers (dehydration, freezing, jam preservation and maceration in vinegar, oil and brine) by which it maintains its medicinal properties. Analyzing the medicinal properties of hot pepper processed in terms of vitamin C, vitamin C content and qualitative analysis of capsaicin by thin layer chromatography (TLC), the most effective processing methods are in order: dehydration, preservation in brine, maceration in oil and preserving as a jam.

REFERENCES

Basu S.K., De A.K., *Capsicum: Historical and Botanical Perspectives*, in De A.K. (Ed.), *Capsicum: The genus Capsicum*, Ed. Taylor and Francis, London, New York, 15-23, 2003.

Beceanu D., Chira A., *Horticultural Products Technology, Valorification in Fresh and Industrialized Condition*, Ed. Economica, București, 23-28, 2003.

Bojor O., Perianu C., *Long Life Pleading: Health through Seeds, Vegetables and Fruits*, Ed. Fiat Lux, Bucureşti, 34-39, 2005.

Broda E., Schonfeld T., *Technical Applications of Radiation*, Ed. Tehnică, București, 1959, 15-21.

Cernătescu C., Cobzaru C., *Spices and Flavorings. Extraction. Identification. Practical Application*, Ed. Pim, Iași, 35-39, 2014.

Cobzaru C., Horoba E., *Natural Extracts. Laboratory Application,* Ed. Pim, Iași, 14-17, 2011.

Georgescu M., *Conservation of Food*, Ed. Andreas, Bucureşti, 56-59, 2014.

MENŢINEREA PROPRIETĂŢILOR MEDICINALE ALE ARDEIULUI IUTE DIN SOIUL *TAM JALAPENO* PRIN CELE MAI EFICIENTE METODE DE PROCESARE

(Rezumat)

Acest studiu îşi propune să evidenţieze cele mai bune metode de procesare ale ardeiului iute din soiul *Tam Jalapeno* prin care acesta îşi menţine proprietăţile medicinale. Ardeiul iute a fost procesat prin iradiere, deshidratare, congelare, conservare sub formă de dulceaţă şi macerare în oţet, ulei şi saramură. Proprietăţile medicinale ale ardeiului iute procesat au fost analizate din punct de vedere al gradului de iute, al conţinutului de vitamina C şi al analizei calitative a capsaicinei cu ajutorul cromatografiei în strat subțire (TLC). Datele experimentale arată faptul că, cele mai eficiente metode prin care produsul procesat îşi menţine proprietăţile medicinale sunt: deshidratarea, conservarea în saramură, macerarea în ulei și conservarea sub formă de dulceață.