Annals of the University of Oradea, Fascicle: Ecotoxicology, Animal Husbandry and Food Science and Technology, Vol. XVIII/A 2019
Analele Universitatii din Oradea, Fascicula: Ecotoxicologie, Zootehnie si Tehnologii de Industrie Alimentara, Vol.XVIII/A 2019

RESEARCH ON THE BEHAVIOUR AND QUALITATIVE CHANGES OF GREEN BEANS

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Abstract

Green beans are very suitable for preservation by freezing. During the freezing and thawing operations some physical-chemical and organoleptic characteristics are changed that are due mainly to the changes in colour, structure-texture and degradation of some components, especially in vitamin C.

Key words: green beans, freezing, colour change, structure-texture, organoleptic properties, vitamin C.

INTRODUCTION

Beans are part of the legume family, being a high-nutrient vegetable that derives from high protein content 22.3% (essential amino acids 8290 mg, non-essential amino acids 12570 mg relative to the protein content) and other components: 44% starch, 44% cellulose, 3.7% pectin, stachyose and raffinose 2%, glucose and sucrose 1.5%, macroelements (potassium 1100, calcium 150, magnesium 103, sodium 40, sulfur 159, phosphorus 541mg/100g product), microelements (iron 5940, iodine 12, manganese 1340, copper 580, nickel 39.4, selenium 24.9, zinc 3210, boron 490, cobalt 18.7, titanium 150, fluorine 44 µ/100 g product) and vitamins (E 3.84 mg%, C 0.09%, biotin 2.10 µ%, niacin 1.20 mg%, pantothenic acid 0.18 mg%, riboflavin 0.50 mg%), (Banu C, 2010).

Green beans have ten times times lower protein and carbohydrate content, and the levels of the other components are reduced compared to the values previously presented (Banu C, 2010).

The green beans are very suitable for preservation by freezing, being a species that retains its pigmentation during the freezing process. Freezing can be done for both scalded and unscalded pods (A. Ardelean, 2013).

Obtaining a quality finished product depends primarily on the quality of the raw material. This quality of the raw material is a variety

characteristic, being greatly influenced by the applied agrotechnics and the pedo-climatic conditions in the area and the respective year.

According to quality, the beans are classified into two quality classes: I and II. For freezing, those of the first quality class are suitable. Thus, the pods should be characteristic of the variety, fresh, young, clean, fresh, whole, with the stem and grains incompletely formed. Also, the pods should be fleshy, with a firm texture before and after scalding, with the slightest tendency to change color, succulent, with a smooth break, without threads, which shows the degree of maturity. The taste and aroma of the pods must be pronounced and specific. The varieties suitable to freezing are those with a diameter of pods less than 10 mm, with a cylindrical shape, and the connection line should be as visible as possible. The rubbed, beaten or attacked pods by diseases and pests (Beceanu D., Chira A., 2003) are not accepted.

During the processing by freezing, as well as during the defrosting, important changes of physico-chemical and organoleptic nature take place.

Changes of a physical nature refer to the loss of water from frozen products by evaporation, when the packaging allows this. If the packaging is impermeable to water vapor and is tightly sealed, the evaporated water from the product crystallizes on the packaging, and evaporation from the outside does not occur. Evaporation occurs both during freezing and during storage. Bulk frozen products lose 0.5 to 1.5% of the water they contain, depending on the nature of the product. In this respect, fast freezing is effective. Water losses are also favored by the too high temperatures in storage spaces and temperature fluctuations. The more frequent and larger, the percentage of water lost from vegetables is higher (Gh. Mihalca et al., 1980).

The loss of water from the superficial tissues leads to another unwanted phenomenon known as the cold burn, manifested by the browning of the tissues. This phenomenon occurs because the oxygen from the atmosphere takes the place of the water lost from the tissues and occurs mainly in improperly packaged products, with leakage defects, due to the advanced dehydration of the superficial tissues. In order to avoid this phenomenon, it is recommended to use waterproof packaging and to ensure high humidity, as close to 100%, without variations (I.Potec et al., 1983, 1985).

Another phenomenon encountered in frozen beans is the detachment of the upper layers of the pod epidermis, which affects the commercial appearance of the finished product and produces some unwanted turbidity in the boiling water. The phenomenon is favored by long-lasting scalding or if boiling has continued longer than necessary.

The colour changes can also occur in unscalded pods, and in the case of the scalded ones it appears completely sporadic. Thus, the colour changes

from green to gray and even to brown, due to browning phenomena. These colour changes occur under the action of oxidative enzymes, being more pronounced and progressing rapidly in acidic environment and in divided products. For these reasons, the scalding operation is performed in saline solution in a concentration of 0.1 - 0.2%, which has the role of inhibiting the activity of these enzymes (Gherghi A., 1995, 1998, I.F.Radu, 1985, 1967).

The defects mentioned above can have other causes: storage of the raw material at room temperature for a longer period; failure to perform the cooling operation after scalding; partial defrosting during storage; storage of frozen products for too long.

Also, the loss of water content in the products has the effect of reducing the weight of the products.

The modification of the structure of the products is also included in the category of physico-chemical modifications, especially those that are scalded. Due to the scalding operation, performed to inhibit the activity of oxidative enzymes and the operation of exposure to freezing by cold, a series of biochemical transformations of esterification take place, which cause changes in the structure of the pectic substances in cell membranes with role in tissue consistency. Thus, the structure-texture becomes looser. The intensity of this phenomenon depends on the species and variety (Mihalca Gh. Et al., 1980).

Among the important chemical changes that take place during the technological flow are the losses of macro and micro elements, of vitamins and especially of vitamin C.

Vitamin C being soluble in water undergoes quantitative changes and slight chemical degradation. Studies have shown that vitamin C is exposed to more severe degradation at – 180 °C, compared to - 250°C, which shows its better stability (A. Monzini, 1970, quoted by Gh Mihalca et al., 1980).

Organoleptic changes refer to diminished losses of aroma, taste and colour.

The studies carried out on the scraped and frozen products allowed to draw some conclusions. First of all the most important ultrastructural changes of the cellular tissues are mainly due to the scalding operations and less to the freezing speeds. However, the higher the freezing rate, the smaller these tissue changes. Also, the young tissues are less affected compared to the aged tissues, and the raw materials do not support better freezing speeds, respectively longer duration, compared to the scalded ones. Referring to beans, heat treatment (scalding) negatively affects the structure of the pods. Under these conditions, the advantages and disadvantages of the scalding operation must be subjected to analysis.

MATERIAL AND METHOD

The research was carried out in 2019, at the Faculty of Environmental Protection Oradea.

Narbone green beans (semi-late varieties) were used in the studies.

The raw material comes from the field culture, being harvested when 70-80% of the pods reached technological maturity, at the beginning of July.

The research was carried out on fresh green bean pods as well as on frozen beans at certain intervals.

The finished frozen product is intended for the preparation of various green bean dishes.

The phases of the technological flow are: harvesting, transport, quantitative and qualitative reception, refrigeration, conditioning (sorting, cutting ends, splitting), scalding, cooling, freezing, packing preparation, packing, storage.

Refrigeration was performed at 40°C for one day, followed by the technological flow.

The splitting was done by cutting into 2 cm long pieces.

Immediately after splitting the pieces of pods were soaked in hot water for one minute, in which 0.2% salt was added to avoid the browning phenomenon.

The freezing was done in the home freezer at - 18ºC, temperature that was kept for two, four months respectively.

The main chemical indicators analyzed, for both fresh and frozen samples, refer to the content in vitamin C. Also, the behavior of beans pods during the technological flow was studied.

For the frozen samples the determinations were made after thawing and the proper preparation of the samples.

The organoleptic properties of fresh and frozen pods were determined by sensory methods. Thus, the appearance of the pods was analyzed in terms of pigmentation and texture, but also the taste and aroma.

RESULTS AND DISSCUSIONS

Immediately after harvesting, analysis samples were carried out, and the results show the average of the determinations.

The content of vitamin C analyzed in fresh and processed green beans are presented in table no. 1

Table no. 1

Sample	Vitamin C (mg/100g)		
	Fresh sample	Frozen sample 2 months	Frozen sample 4 months
1	19	15.8	14.2
2	19	15.5	14.0
3	18	15.2	13.8
4	20	16.7	15.2
5	21	17.7	16.5
Average of samples	19.4	16.18	14.7

From the obtained results we can see a decrease in the content of vitamin C higher in frozen samples for two months, about 17% and 24.3% for frozen ones for 4 months.

This decrease of the vitamin C content of 17% is due on the one hand to the scalding operation in hot water, the vitamin C being soluble, as well as due to the freezing operation with slow speed.

After another two months of freezing, the decreases in vitamin C content are diminished, due to its stability at low temperatures. This diminished decrease and stability of vitamin C after a period of 4 months of freezing at - 180°C can be explained by maintaining the temperature recorded at this value, the finished product not being exposed to temperature fluctuations.

Regarding the texture of scalded and frozen pods, changes are observed. This has become much looser, due to changes in the structure of pectic substances in the cell membranes with a role in tissue consistency, changes that occur both during scalding and by exposure to freezing. However, no detachments of the superficial layers of the epidermis of the pods were reported, even though they were scalded.

This is due, first of all, to the correct execution of the scalding operation as a duration and temperature, but also due to the variety, which has no sensitivity to heat treatments, being a variety that is well suited for industrialization.

The following indicators: colour, taste, aroma were also analyzed by organoleptic methods.

The colour has undergone slight changes. Thus, the green colour lost its shine, during the scalding and storage, the chlorophyll gradually turned into an olive-green pheophytin.

Due to the sealed polyethylene packages and the lack of humidity and temperature variations throughout storage, no phenomena of browning and cold burning were reported.

The taste and aroma have also changed, so they are no longer pronounced, being diminished during storage. Due to the fact that the scalding action was performed, the action of the lipase enzymes was inhibited and, as a result, the frozen product did not acquire the taste of "hay", which is due to the action of these enzymes.

CONCLUSIONS

The following conclusions are drawn from the analysis of the results regarding the qualitative changes in the frozen green bean samples:

1. Vitamin C content decreased more during the first 2 months of storage, after which the loss diminished, reaching a stability of value;
2. Changes in the structure and texture of the scalded and frozen pods appear, which becomes looser, but without phenomena of detachment of the superficial layers of the epidermis;
3. The colour has undergone slight changes, transforming during storage into olive-green;
4. The phenomena of browning and cold burning were not reported, due to the sealed polyethylene packages and the lack of humidity and temperature variations throughout the storage period;
5. The taste and aroma have lost their intensity during the four months of storage, but without the appearance of "hay" taste;

6. Green bean is a species that is very suitable to preservation by freezing in the scalded version;
7. Due to the biological peculiarities of green bean pods, it is recommended to carry out the harvesting operations at the optimum harvesting time, without exceeding the technological maturity phase and using the varieties that are suitable for industrialization;

8. It is recommended to perform the scalding operation as a result of the qualitative advantages over the finished product;
9. The use of waterproof, sealed packaging is absolutely mandatory to obtain a quality finished product;
10. It is recommended to continue the research on freezing green bean pods also in the unscalded version.

REFERENCES

1. A. Ardelean, 2019, Mărul- Tehnologia culturii, Posibilități de păstrare și depozitare, Conservare și prelucrare, Editura Universității Oradea.
2. Ardelean Alina Grigorița, 2009, Tehnologii de conservare a legumelor și fructelor, Îndrumător de lucrări practice, Editura Treira, Oradea
3. Ardelean Alina Grigorița, 2013, Tehnologii de prelucrare și păstrare a legumelor și fructelor, Editura Universității din Oradea
4. Ardelean Alina Grigorița, 2015, Tehnologii de prelucrare și conservare a legumelor și fructelor, Îndrumător de laborator, Editura Universității din Oradea
5. Banu C., 1992, Progrese tehnice, tehnologice și științifice în industria alimentară, Editura Tehnică, București
6. Carmen Hura, 2006, Ghid de laborator, Metode de analiză pentru produsele alimentare, Editura tehnică, științifică și didactică CERMI Iași
7. Cornelia Purcărea, 2005, Biochimie Agro- Alimentară, Editura Universității Oradea
8. Cornelia Purcărea, 2008, Transformări biochimice importante în produsele agroalimentare în timpul procesării și depozitării, Editura Universității Oradea
9. Dumitru Beceanu, Adrian Chira, 2003, Tehnologia produselor horticole, Valorificare în stare proaspătă și industrializare, Editura Economică București
10. Gh. Mihalca și col., 1980, Congelarea produselor horticole și prepararea lor pentru consum, Editura tehnică București
11. Gherghi A., 1995, Tehnologia valorificării produselor horticole, Universitatea Indep. Tita Maiorescu, București
12. Gherghi A., 1998, Valorificarea produselor horticole, interfață între producție și consum, Revista Hortinform, nr.3/1998, București
13. I. F. Radu, 1985, Tratat de tehnologie a fructelor și legumelor, Scrisul românesc, Craiova
14. I. F. Radu, A Gherghi, 1967, Păstrarea și prelucrarea produselor hortiviticole, Editura Agro- Silvică București

15. Inoue K. și colab.,1998, Production of ascorbic acid enriched vegetables, Journal of Horticulture Science & Biotechnology 5(73)
16. Ioancea L. și colab., 1998, Condiționarea și valorificarea superioară a materiilor prime vegetale în scopuri alimentare. Tehnologii și instalații, Editura Ceres, București
17. Marca Gh., 1987, Tehnologia păstrării și industrializării produselor horticole, Cluj- Napoca
18. Neamțu G. și colab,1993, Biochimie vegetală, Editura Didactică și Pedagogică, București
19. Neamțu G. și colab,1997, Biochimie alimentară, Editura Ceres, București
20. Potec I. și colab., 1985, Tehnologia păstrării și industrializării produselor horticole, Lucrări practice, I.A.I., Facultatea de Horticultură, Iași
21. Potec și col., 1983, Tehnologia păstrării și industrializării produselor horticole, Editura didactică și pedagogică București