CAIRO UNIVERSITY
INSTITUTE OF AFRICAN RESEARCH AND STUDIES

AFRICAN STUDIES REVIEW

* Effect of Blanching and Freezing on Nutritive Value of Some Vegetables in Sudan
* Nutritive Value of Some Fresh Vegetables Used in Food Processing in Sudan

ISSUE 36 2014

Cairo Univ. Stud. Rev. Vol. (36) (2014) : 1 - 12

Effect of Blanching and Freezing on Nutritive Value of Some Vegetables in Sudan

By

Osama Nuri Sabir Mohamed Nur[(1)],
Hattim Makki Mohamed Makki[(2)],
Yosry Ahmed Abdel-daim[(3)]

Abstract :

This study was intended to investigate the nutritional value (moisture, protein, fat, carbohydrate, fiber, ash, ascorbic acid and minerals) for two types of frozen vegetables (okra and green beans). The results of okra showed 83.87, 84.78 and 85.92% moisture, 1.42, 1.37 and 1.32% protein, 0.46, 0.38 and 0.35% fat, 7.54, 7.56 and 6.80% carbohydrate, 5.92, 5.23 and 4.94% fiber, 0.79, 0.68 and 0.67% ash, 38.13, 27.02 and 26.57 mg/100g ascorbic acid, 226.27, 184.61 and 126.83 mg/100g sodium, 794.31, 676.64 and 656.37 mg/100g potassium, 402.56, 326.48 and 309.59 mg/100g calcium, 678.72, 561.29 and 556.42 mg/100g magnesium content, for fresh, after blanching and after freezing process, respectively. The results of green beans had 86.52, 87.76 and 87.68% moisture, 1.82, 1.76 and 1.72% protein, 0.43, 0.38 and 0.36% fat, 5.06, 3.63 and 4.06% carbohydrate, 6.31, 5.70 and 5.43% fiber, 0.86, 0.77 and 0.75% ash, 56.32, 44.85 and 38.68 mg/100g ascorbic acid, 127.03, 93.25 and 75.38 mg/100g

(1) 1osamanuri@hotmail.com

(2) Department of Food Science and Technology, College of Agricultural Studies, Sudan University of Science and Technology, Khartoum, Sudan, hatimmakki@sustech.edu

(3) Department of Food Science, Faculty of Agriculture, Ain-Shams University, Cairo, Egypt, dr_yosryahmed@hotmail.com

sodium, 712.43, 606.34 and 586.53 mg/100g potassium, 407.65, 302.52 and 292.64 mg/100g calcium, 637.18, 558.71 and 551.27 mg/100g magnesium content, for fresh, after blanching and after freezing process, respectively. This study showed that blanching and freezing delays the degradation of nutritive value of frozen vegetable products.

Key words: Vegetables; Moisture; Protein; Fat; Carbohydrate; Fiber; Ash; Ascorbic acid; Minerals content.

INTRODUCTION

As a pre-freezing process, blanching is used to inactivate enzymes that cause detrimental changes in color, flavor and nutritive value during frozen storage **(Brewer et al., 1995)**; however, this treatment can also cause loss of such characteristics **(Murcia et al., 2000)**. According to **Brewer et al. (1994),** the loss of water-soluble minerals and vitamins during blanching should also be minimized by keeping blanching time and temperature at an optimum combination. Almost every vegetable needs to be blanched and rapidly cooled prior to freezing **(Sipos et al., 2009)**, and this process is usually achieved with the use of heat (boiling water, steam or microwave) for a short period of time. Blanching is usually carried out between 75 and 95ºC for 1 to 10 minutes, depending on the size of individual vegetable pieces **(Thane and Reddy 1997)**. Steam blanching takes longer than the water method, but helps retain water-soluble nutrients, such as some vitamins and minerals **(Barbosa-Cánovas et al., 2005)**. After blanching, the product should be rapidly cooled down to minimize the degradation of heat-labile nutrients **(Barbosa-Cánovas et al., 2005)**.

According to **Selman (1992),** freezing process itself does not alter the nutritive value of the product being frozen. It is during the preparative steps prior to freezing, particularly blanching, and during

subsequent frozen storage that losses of more labile vitamins occur **(Czarnowska and Gujska 2012). Scott and Eldridge (2004)** indicate that freezing step generally has no significant effect on the vitamins content of vegetables. Research done by **Ninfali and Bacchiocca (2003)** on freezing using a Lewis individual quick freezing (IQF) tunnel and blast freezer also did not show differences in ascorbic acid content of vegetables. **Lisiewska and Kmiecik (1991)** also reported no effect of freezing on the content of thiamin and riboflavin of vegetables, and this concept could also be extended to other components of vegetables. According to **Thane and Reddy (1997),** the amount of carotenoids is also not affected by freezing, particularly rapid freezing. Deteriorative process occurs, although at a very low rate, during storage. This is desirable, of course, because of the high value placed on carotenoids as nutrients.

MATERIALS AND METHODS

Samples preparation

The fresh vegetables samples were collected from local market and the fresh samples were washed under running tap water and kept on 4 °C until needed of analysis. Also, another vegetables samples were collected after blanching and freezing and kept on -18 °C until needed for the different investigations. Moreover, all the chemicals used in this study were of analytical grade.

Chemical composition

Moisture, protein, fat, fiber and ash were determined according to **AOAC (2010)**. The carbohydrate content was determined by difference. Ascorbic acid was determined according to **Ruck method (1963)** in the manner described by **El-obeid (2003),** and minerals were extracted according to **Pearson's method (1981),** potassium and

sodium contents of each extracted sample were determined according to **AOAC (2010)** using flame photometer, calcium content was determined according to **Champman and Pratt (1968),** magnesium content was determined according to **Pearson's method (1981)** with some modifications.

RESULTS AND DISCUSSION

Moisture content

Moisture content of okra sample was 83.87, 84.78 and 85.92%, while, of green beans sample was 86.52, 87.76 and 87.68% for fresh, after blanching and after freezing process, respectively. The water may be increased due to the loss of solid content during blanching time **(Torreggiant et al., 2000)**. The sublimation of ice at the surface can also occur during storage in improperly packaged food, leading to desiccation and causing undesirable weight loss **(Sun, 2006)**.

Protein content

Protein content of okra sample was 1.42, 1.37 and 1.32%, meanwhile, of green beans sample was 1.82, 1.76 and 1.72% for fresh, after blanching and after freezing process, respectively. The changes in nutrients and other components, such as proteins during blanching of vegetables was conservation of soluble nutrients. The soluble solids of frozen vegetables did not change significantly during freezing **(Sipos et al., 2009)**.

Fat content

Fat content of okra sample was 0.46, 0.3 and 0.35%, as well as of green beans sample was 0.43, 0.3 and 0.36% for fresh, after blanching and after freezing process, respectively. **Puupponen- Pimiä et al. (2003)** mentioned the importance of enzymatic inactivation by blanching to prevent degradation of total fatty acids in vegetables.

Carbohydrate content

Carbohydrate content of okra sample was 7.54, 7.56 and 6.80%, while of green beans sample was 5.06, 3.63 and 4.06% for fresh, after blanching and after freezing process, respectively. The soluble solids of frozen vegetables did not change significantly during freezing. The amount of total and individual sugars also did not change much **(Sipos et al., 2009)**.

Fiber content

Fiber content of okra sample was 5.92, 5.23 and 4.94%, as well as of green beans sample was 6.31, 5.70 and 5.43% for fresh, after blanching and after freezing process, respectively. According to **Puupponen-Pimiä et al. (2003),** dietary fiber components were rather stable during blanching, and they were either not affected. The explanation would be the mechanical disruption of cells during processing that might have resulted in better extraction of fiber components **(Czarnowska and Gujska 2012)**.

Ash content

Ash content of okra sample was 0.79, 0.68 and 0.67%, while, of green beans sample was 0.86, 0.77 and 0.75% for fresh, after blanching and after freezing process, respectively. Some of industrial processing implies carrying out a series of prior operations to prepare the products, such as washing and blanching, can signify a decrease in mineral content of vegetables **(Polo et al., 1992)**. Frozen vegetables after storage period which a statistically significant decrease in ash content compared with the blanched material was recorded **(Waldemar et al., 2000)**.

Ascorbic acid content

Ascorbic acid content of okra sample was 38.13, 27.02 and 26.57 mg/100g, and of green beans sample was 56.32, 44.85 and 38.68 mg/100g for fresh, after blanching and after freezing process, respectively. The blanching caused obvious decrease in vitamin C content due to oxidation, high solubility in water and high sensitivity to heat **(Hui et al., 2004). Martins and Silva (2003)** reported that, improper frozen storage causes evident changes in sensory characteristics that can influence consumer acceptability, but also leads to products reduced nutritive value, mainly in vitamin C.

Sodium content

Sodium content of okra sample was 226.27, 184.61 and 126.83 mg/100g, and of green beans sample was 127.03, 093.25 and 075.38 mg/100g for fresh, after blanching and after freezing process, respectively.

Potassium content

Potassium content of okra sample was 794.31, 676.64 and 656.37 mg/100g, and of green beans sample was 712.43, 606.34 and 586.53 mg/100g for fresh, after blanching and after freezing process, respectively.

Calcium content

Calcium content of okra sample was 402.56, 326.48 and 309.59 mg/100g, and of green beans sample wand 407.65, 302.52 and 292.64 mg/100g for fresh, after blanching and after freezing process, respectively.

Magnesium content

Magnesium content of okra sample was 678.72, 561.29 and 556.42 mg/100g, and of green beans sample was 637.18, 558.71 and 551.27 mg/100g for fresh, after blanching and after freezing process, respectively. Among minerals, potassium content was often decreased during blanching. The authors indicate that the behavior of minerals during blanching is related to the solubility. Potassium, the most abundant mineral in vegetables **(Sipos et al., 2009)**, is extremely mobile and is easily lost by leaching during blanching because of its high solubility in water. Calcium and magnesium are generally bound to the plant tissue are not readily lost by leaching, and sometimes can even be taken up by vegetables during blanching from the processing water in areas with hard water **(Van den Berg et al., 2000)**.

Table 1: Effect of blanching and freezing process on okra nutritive value

Item	Fresh farm	After blanching	After freezing process
Moisture %	83.87 ± 0.01	84.78 ± 0.03	85.92 ± 0.04
Protein %	1.42 ± 0.03	1.37 ± 0.01	1.32 ± 0.06
Fat %	0.46 ± 0.01	0.38 ± 0.04	0.35 ± 0.02
Total carbohydrate %	7.54 ± 0.05	7.56 ± 0.03	6.80 ± 0.01
Fiber %	5.92 ± 0.06	5.23 ± 0.05	4.94 ± 0.03
Ash %	0.79 ± 0.03	0.68 ± 0.04	0.67 ± 0.01
Ascorbic acid mg/100g	38.13 ± 0.06	27.02 ± 0.03	26.57 ± 0.02
Sodium mg/100g	226.27 ± 0.01	184.61 ± 0.02	126.83 ± 0.05
Potassium mg/100g	794.31 ± 0.03	676.64 ± 0.04	656.37 ± 0.01
Calcium mg/100g	402.56 ± 0.04	326.48 ± 0.01	309.59 ± 0.06
Magnesium mg/100g	678.72 ± 0.01	561.29 ± 0.05	556.42 ± 0.03

Table 2: Effect of blanching and freezing process on green beans nutritive value

Item	Fresh farm	After blanching	After freezing process
Moisture %	86.52 ± 0.03	87.76 ± 0.04	87.68 ± 0.05
Protein %	1.82 ± 0.05	1.76 ± 0.03	1.72 ± 0.06
Fat %	0.43 ± 0.03	0.38 ± 0.01	0.36 ± 0.04
Total carbohydrate %	5.06 ± 0.04	3.63 ± 0.02	4.06 ± 0.05
Fiber %	6.31 ± 0.03	5.70 ± 0.01	5.43 ± 0.02
Ash %	0.86 ± 0.02	0.77 ± 0.04	0.75 ± 0.01
Ascorbic acid mg/100g	56.32 ± 0.05	44.85 ± 0.01	38.68 ± 0.03
Sodium mg/100g	127.03 ± 0.01	093.25 ± 0.03	75.38 ± 0.04
Potassium mg/100g	712.43 ± 0.03	606.34 ± 0.05	586.53 ± 0.01
Calcium mg/100g	407.65 ± 0.06	302.52 ± 0.03	292.64 ± 0.02
Magnesium mg/100g	637.18 ± 0.01	558.71 ± 0.04	551.27 ± 0.03

REFERENCES

- **AOAC, (2010).** Official Methods of Analysis, **Association of Official Analytical Chemists, Inc., USA**.
- **Champman, H. D. and Pratt, F. P., (1968).** Ammonium molybdate – Ammonium vanadate method for determination of Phosphorus, Methods of analysis of soil, plants and water. **California University, public division of agric. Sci., pp. 169-170**.
- **Barbosa-Cánovas, G., Altunakar, B. and Mejía-Lorío, D. (2005).** Introduction to freezing. In: Freezing of Fruits and Vegetables. Food and **Agriculture Organization of the United Nations (FAO), Rome, Italy, pp. 1-36**.
- **Brewer, S., Begum, S. and Bozeman, A. (1995).** Microwave and conventional blanching effects on chemical, sensory and color characteristics of frozen broccoli. **Journal of Food Quality, 18: 479-493**.
- **Brewer, S., Klein, B., Rastogi, B. and Perry, A. (1994).** Microwave blanching effects on chemical, sensory and color characteristics of frozen green beans. **Journal of Food Quality, 17: 245-259**.
- **Czarnowska, M. and Gujska, E. (2012).** Effect of freezing technology and storage conditions on folate content in selected vegetables. **Plant Foods Hum. Nutr., 67: 401-406**.
- **El-obeid, S.M. (2003).** A biochemical study on dehydrated whole limes (Citrus aurantifdia) for export. **M. Sc. Agric. Thesis, Food Science and Technol. Dep., Faculty of Agriculture, University of Khartoum, Sudan**.
- **Hui, Y., Chazala, S., Graham, D., Murrell, K. and Nip, W. (2004).** Handbook of Vegetables Preservation and Processing, Marcel Dekker, **New York, USA. pp. 201-284**.
- **Lisiewska, Z. and Kmiecik, W. (1991).** Thiamin and riboflavin contents in fresh and preserved (freezing, canning) broad bean seeds. Acta **Alimentaria Polonica, 17 (1): 41-48**.
- **Martins, R. and Silva, C. (2003).** Kinetics frozen stored green beans (Phaseolus vulgaris, L.) quality changes: texture, vitamin C, reducing sugars and starch. **Journal of Food Science, 68 (7), 2232-2237**.
- **Murcia, M., López-Ayerra, B., Martinez-Tomé, M., Vera, A. and García-Carmona, F. (2000).** Evaluation of ascorbic acid and peroxidase during industrial processing of broccoli. **Journal of the Science of Food and Agriculture, 80: 1882-1886**.

- **Ninfali, P. and Bacchiocca, M. (2003).** Polyphenols and antioxidant capacity of vegetables under fresh and frozen conditions. **Journal of Agricultural and Food Chemistry, 51: 2222-2226**.
- **Pearson, D. (1981).** Pearson's Chemical Analysis of Foods. Egan, H., Kirk, R. S. and Sawver, R. (eds) 18th ed., **London, New York**.
- **Polo, M., Lagarda, M. and Farreâ, R. (1992).** The effect of freezing on mineral element content of vegetables. **J. Food Comp. Anal., 5: 77-83**.
- **Puupponen-Pimiä, R., Häkkinen, S., Aarni, M., Suortti, T., Lampi, A-M., Eurola, M., Piironen, V., Nuutila, A. and Oksman-Caldentey, K-M. (2003).** Blanching and long-term freezing affect various bioactive compounds of vegetables in different ways. **Journal of the Science of Food and Agriculture, 83: 1389-1402**.
- **Ruck, J.A. (1963).** Chemical method for analysis of fruit and vegetable products. **Dep. Of Agric. Canada**.
- **Scott, C. and Eldridge, A. (2004).** Comparison of carotenoid content in fresh, frozen and canned corn. **Journal of Food Composition and Analysis, 18: 551-559**.
- **Selman, J. (1992).** Vitamin retention during blanching of vegetables. Presented at *the Royal Society of Chemistry Symposium 'Vitamin Retention in Cooking and Food Processing*', **24 November, London, UK: 137-147**.
- **Sipos, P., Katai, Z., Barancsi, A., Mezei, Z., Borbely, M., Gyori, Z. (2009):** Effect of freezing and desiccation filiations on the biologically active compounds of fruits, Processing and energy, **JDPTEP, 13(3):293-294**.
- **Sun, D. (2006).** Handbook of Frozen Food Processing And Packaging. **CRC press, LLC, Boca Roton, Florida, USA. pp. 377-416 and 521-534**.
- **Thane, C. and Reddy, S. (1997).** Processing of fruit and vegetables: effect on carotenoids. **Nutrition & Food Science, 2: 58-65**.
- **Torreggiani, D., Lucas, T. and Raoult, W. (2000).** The Pre-treatment of Fruits and Vegetables. In: Managing Frozen Foods. Kennedy, C., **CRC press, LLC, Boca Raton, Florida, USA. Pp. 57-80**.
- **Van den Berg, H., Faulks, R., Granado, H., Hirschberg, J., Olmedilla, B., Sandmann, G., Southon, S. and Stahl, W. (2000).** The potential for the improvement of carotenoid levels in foods and the likely systemic effects. **Journal of the Science of Food and Agriculture, 80: 880-912**.
- **Waldemar, K., Lisiewska, Z. and Jaworska, G. (2000).** Content of ash components in the fresh and preserved broad bean (*Vicia faba v. major*). **J. Food Composition and Analysis, 13: 905-914**.

تأثير السلق والتجميد على القيمة التغذوية لبعض الخضروات في السودان

أسامه نوري صابر محمد نور[١]، حاتم مكي محمد مكي[٢]، يسري أحمد عبدالدايم[٣]

الملخص :

أجريت هذه الدراسة لتحديد القيمة التغذوية (محتوى الرطوبة ، محتوى الرماد، محتوى البروتين، محتوى الدهون، محتوى الكربوهيدات، محتوى الألياف، محتوى حمض الأسكوربيك، محتوى المعادن) لنوعين من الخضروات المجمدة (البامية والفاصوليا الخضراء). أظهرت نتائج البامية ٨٣,٨٧، ٨٤,٧٨ و٨٥,٩٢٪ محتوى رطوبي، ١,٤٢، ١,٣٧ و١,٣٢٪ محتوى بروتيني، ٠,٤٦، ٠,٣٨ و٠,٣٥٪ محتوى دهوني، ٧,٥٤، ٧,٥٦ و٦,٨٠٪ محتوى كربوهيداتي، ٥,٩٢، ٥,٢٣ و٤,٩٤٪ محتوى الألياف، ٠,٧٩، ٠,٦٨ و٠,٦٧٪ محتوى الرماد، ٣٨,١٣، ٢٧,٠٢ و٢٦,٥٧ ملجم/١٠٠جم محتوى حمض الأسكوربيك،٢٢٦,٢٧، ١٨٤,٦١ و١٢٦,٨٣ ملجم/١٠٠جم محتوى الصوديوم، ٧٩٤,٣١، ٦٧٦,٦٤ و٦٥٦,٣٧ ملجم/١٠٠جم محتوى البوتاسيوم، ٤٠٢,٥٦، ٣٢٦,٤٨ و٣٠٩,٥٩ ملجم/١٠٠جم محتوى الكالسيوم، ٦٧٨,٧٢، ٥٦١,٢٩ و٥٥٦,٤٢ ملجم/١٠٠جم محتوى الماغنسيوم، للعينات الطازجة، بعد عملية السلق وبعد عملية التجميد، على التوالي. أظهرت نتائج الفاصوليا الخضراء ٨٦,٥٢، ٨٧,٧٦ و٨٧,٦٨٪ محتوى

(١) osamanuri@hotmail.com

(٢) قسم علوم وتكنولوجيا الأغذية – كلية الدراسات الزراعية – جامعة السودان للعلوم والتكنولوجيا – الخرطوم – السودان - hatimmakki@sustech.edu

(٣) قسم علوم الأغذية – كلية الزراعة – جامعة عين شمس – القاهرة – مصر - dr_yosryahmed@hotmail.com

الرطوبة، ١,٨٢، ١,٧٦ و١,٧٢٪ محتوى البروتين، ٠,٤٣، ٠,٣٨ و٠,٣٦٪ محتوى الدهون، ٥,٠٦، ٣,٦٣ و٤,٠٦٪ محتوى الكربوهيدات، ٦,٣١، ٥,٧٠ و٥,٤٣٪ محتوى الألياف، ٠,٨٦، ٠,٧٧ و٠,٧٥٪ محتوى الرماد، ٥٦,٣٢، ٤٤,٨٥ و٣٨,٦٨ ملجم/١٠٠جم محتوى حمض الأسكوربيك،١٢٧,٠٣، ٩٣,٢٥ و٧٥,٣٨ ملجم/١٠٠جم محتوى الصوديوم، ٧١٢,٤٣، ٦٠٦,٣٤ و٥٨٦,٥٣ ملجم/١٠٠جم محتوى البوتاسيوم، ٤٠٧,٦٥، ٣٠٢,٥٢ و٢٩٢,٦٤ ملجم/١٠٠جم محتوى الكالسيوم، ٦٣٧,١٨، ٥٥٨,٧١ و٥٥١,٢٧ ملجم/١٠٠جم محتوى الماغنسيوم، وذلك بالنسبة للعينات الطازجة، بعد السلق وبعد عملية التجميد ، على التوالي. اظهرت الدراسة أن السلق والتجميد يؤخران تدهور القيمة الغذوية لمنتجات الخضروات المجمدة.