2013 International Nuclear Atlantic Conference - INAC 2013
Recife, PE, Brazil, November 24-29, 2013
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: **978-85-99141-05-2**

Colorimetric analysis of edible flower of *Dendranthema grandiflorum* processed by ionizing radiation

Amanda C. Ramos Koike[1], Flávio Thihara Rodrigues[1], Gustavo Bernardes Fanaro[1] and Anna Lucia C. H. Villavicencio[1]

[1] Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-000 São Paulo, SP
amandaramosk@gmail.com

ABSTRACT

Edible flowers can be used to add flavor, color, taste and visual appeal to culinary preparations as salads, soups, desserts and drinks. There are many edible flowers rich in minerals, vitamins, pollen, nectar and other essential nutrients that are important for human nutrition. Food irradiation is a viable technology for disinfestation of insect, to increase extending the shelf life of perishable products and improving the hygienic quality of food. The irradiation technology is a good alternative method to replace chemical fumigation of pest insects present in foods and flowers. The purpose of this study was evaluate the color of *Dendranthema grandiflorum* exposed low-dose ionizing radiation: 0.3 kGy, 0.4 kGy, 0.5 kGy, 0.6 kGy, 0.7 kGy, and 0.8 kGy of ^{60}Co using colorimeter (Konica Minolta Chroma Meter CR-400), were used samples of chrysanthemum in yellow, white and red. The petals of the flowers were used for the chromaticity value. The samples of irradiated chrysanthemus (white, yellow and red) processed with 0.3 to 0.6 kGy haven´t shown significantly difference when compared to the control sample, the dose of 0.3 kGy, dose it is necessary to sterilize.

1. INTRODUCTION

Edible flowers have been used in the culinary creations for flavor and garnish for hundreds of years, in China and Japan, have been consumed for thousands of years. Edible flowers are used baking, sauces, jelly, syrup, flavored liquors, vinegars, honey, oil, tea, candied flowers, ice cubes, salads and some flowers may be dried and used as dried herbs [1-2].

The assortment of edible flowers involves several tens of inflorescences which differ in taste, color and shape, these are used to improve flavor, appearance and nutritive value the culinary preparations. Sensory characteristics attractive as appearance, flavor, taste, size, shape and coloring represent the most important criteria of quality of edible flowers and color is one of the major attributes which affects the consumer perception of quality. [2-3-4].

Edible flowers are highly perishable product and must be free from insect pests, which may represent a challenge since edible flowers must be grown without the use of any chemical pesticide [5].

Dendranthema grandiflorum (chrysanthemums) native to China and Japan, are perennial plants with the flowering yields attractive spikes of brown, red, yellow, pink, reddish-orange or white flowers in the spring and fall. The petals have a mild to strong bitter taste, use in salad, soup, tea and can also be prepared as tempura [1-6].

Irradiation of food is the use of ionizing radiations from isotopes of cobalt or from accelerators to food safety, insect disinfestation, reduce microbial contamination and increase the shelf- life of food. Ionizing radiation is applied to foods to improve their keeping quality [7-8].

Safety and efficiency food irradiation has been approved by World Heath Organization (WHO), International Atomic Energy Agency (IAEA) and Food Agriculture Organization (FAO) [9-10]. The ionizing radiations do not cause any significant alteration the important sensory properties of most food are not influenced at low radiation doses [11].

Flowers are relatively sensitive in ionizing radiations, the damage caused by radiation in flowers are color changes in petals, trunk bent, injury, bud opening and petal wilting. The irradiation technology is a good alternative method to substitute chemical fumigation in disinfestation the insect in food and flowers [12-13].

The purpose of this study was evaluate the color of *Dendranthema grandiflorum* in colors yellow, white and red exposed low-dose ionizing radiation.

2. MATERIAL AND METHODS

2.1 Sample

Samples of *Dendranthema grandiflorum* in were purchased from local market in São Paulo, Brazil, were used chrysanthemum in yellow, white and red (FIG.1) The samples were packaged in polyethylene (13×10×4 cm) with five flowers by species.

Figure 1: ***Dendranthema grandiflorum***

2.2 Irradiation

The samples were irradiated at Nuclear and Energy Research Institute – IPEN/CNEN (São Paulo, Brazil) using a ^{60}Co Gammacell 200 (MDS Nordion Ottawa, Canadá) at doses of 0, 0.3 kGy, 0.4 kGy, 0.5 kGy, 0.6 kGy, 0.7 kGy, and 0.8 kGy. After irradiation, sample were stored in a cold chamber at 8ºC.

2.3. Colorimetric analysis

The colorimetric analysis was conducted using colorimeter (CR-400 Chroma; Konica Minolta, Osaka, Japan). The colorimeter was calibrated with standard calibration white plate (CR-A43) and configuration L * a * b * where L: luminosity (relative darkness or lightness) an value of L* = 100 represents pure white and L* = 0 represents pure black; a* is chromaticity coordinate (+a*:red; -a*:green) and the b* is chromaticity coordinate (+ b*:yellow; -b*:blue) [14].

The analyses were performed in triplicate and the colorimeter was positioned in a vertical ma nner in the middle of each petal to ensure equal measurement conditions. Was used as standar d control group (0 kGy), in order to obtain consistent results.

2.4 Statistical Analysis

The results of the color were submitted to analysis of variance (ANOVA) at a significance le vel of 95% ($P < 0.05$). The means comparison were used Tukey test for analyses of color.

3. RESULTS AND DISCUSSION

Appearance is a sensory characteristic of the food, composed from color, brightness, size and shape. Color is related to the fresh quality foods, becoming the first criteria applied to its acceptance or rejection by consumers [15].

3.1 Colorimetric analysis: yellow chrysanthemums

The color analyses for of yellow chrysanthemums are shown in Figures 2, 3 and 4. We could observe in Figure 2 that L* parameter (brightness) did not show a statiscal difference between non-irradiated and irradiated samples.

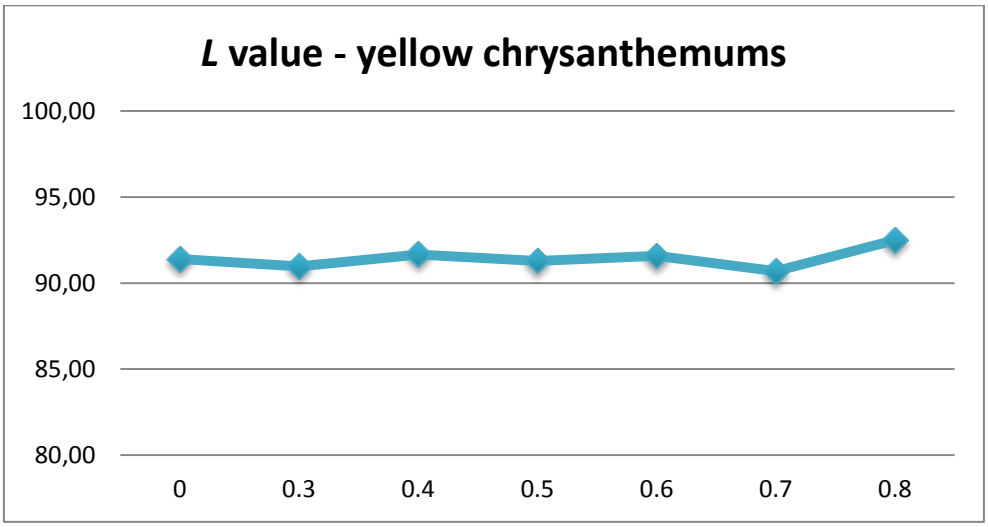

Figure 2. *L* Parameter (brightness) of yellow chrysanthemums at different doses (mean values)

Figure 3, the a* parameter (+ red; - green) showed that the irradiated samples remained with the same characteristics of the control sample.

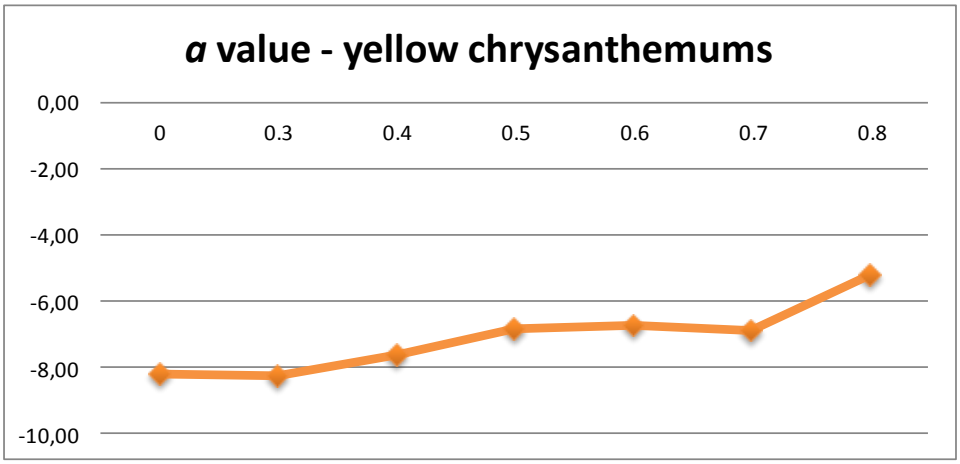

Figure 3. a Parameter of yellow chrysanthemums at different doses (mean values)

The results for the achromatic b * (yelow; - blue) FIG. 4 showed that the irradiated sample starting 0.5 kGy differ significantly of non-irradiated samples. However the samples processed with 0.3 and 0.4 kGy remained with the same characteristics of the control.

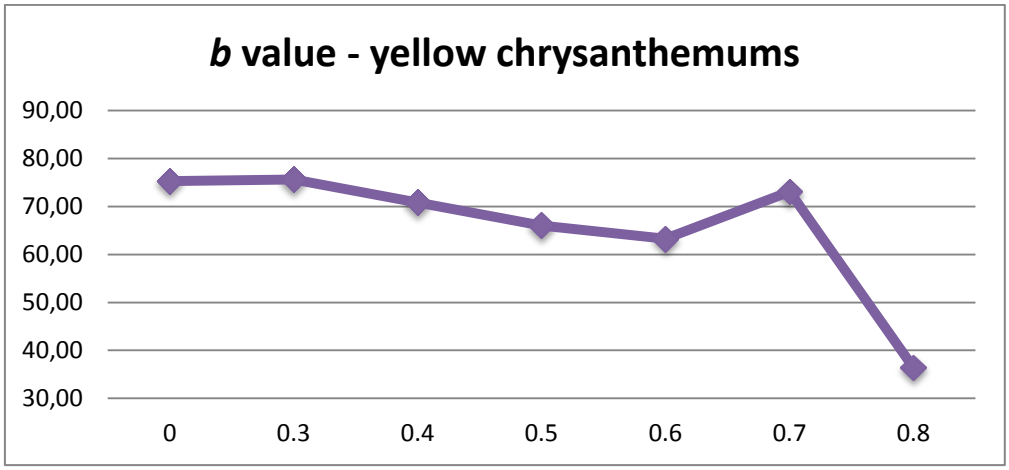

Figure 4. *b* Parameter of yellow chrysanthemums at different doses (mean values)

Evaluate color of in nature peach palm, such as color and texture, after of e-beam processing, samples were irradiated 1.0 and 2.0kGy. Colour analysis results showed a significant change mainly with samples irradiated with 2.0kGy [16]

3.2 Colorimetric analysis: white chrysanthemums

The results of color analyses for of white chrysanthemums are shown in Figures 5, 6 and 7. We could observe in Figure 5 that L* parameter did not show a statiscal difference between non-irradiated and irradiated.

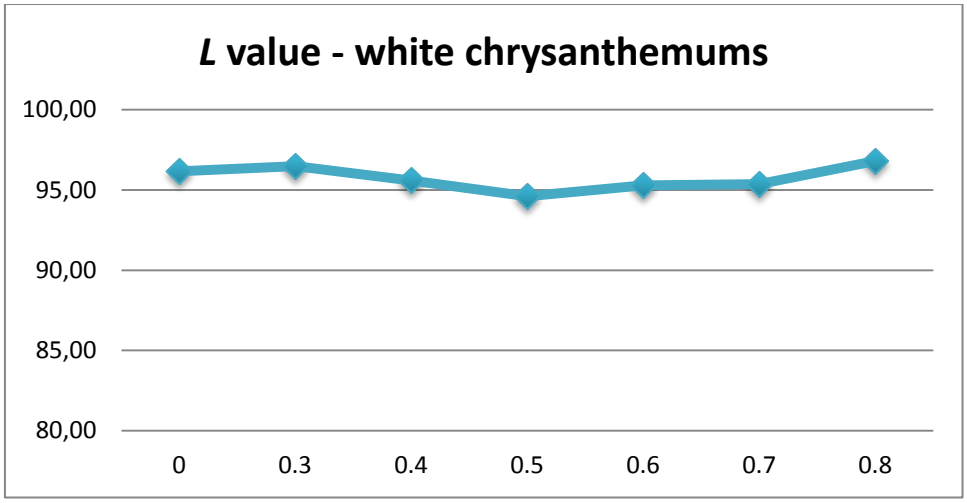

Figure 5. *L* Parameter (brightness) of white chrysanthemums at different doses (mean values)

Figure 6, the results for the a* parameter showed that the irradiated sample starting 0.4 kGy differ significantly of non-irradiated samples. However the sample processed with 0.8 kGy remained with the same characteristics of the control. Similar results were obtained for achromatic component b (Figure 7).

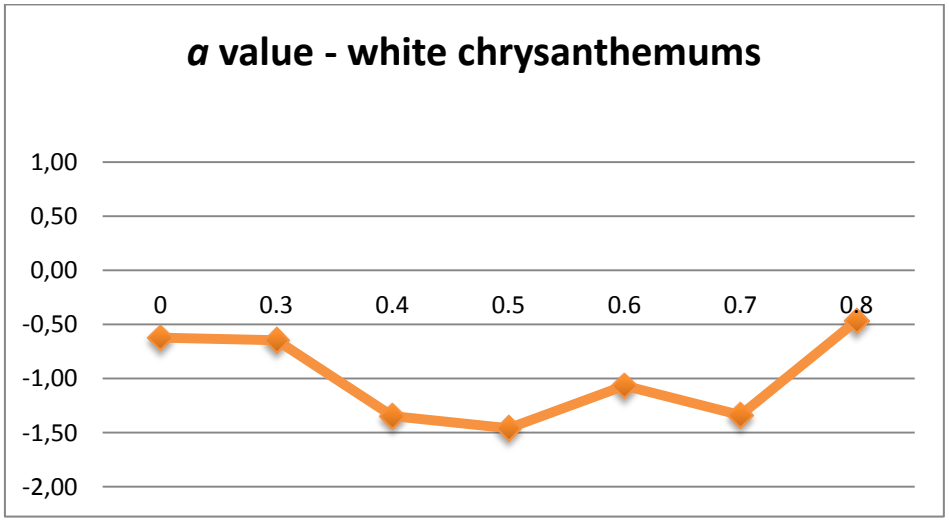

Figure 6. *a* Parameter of white chrysanthemums at different doses (mean values)

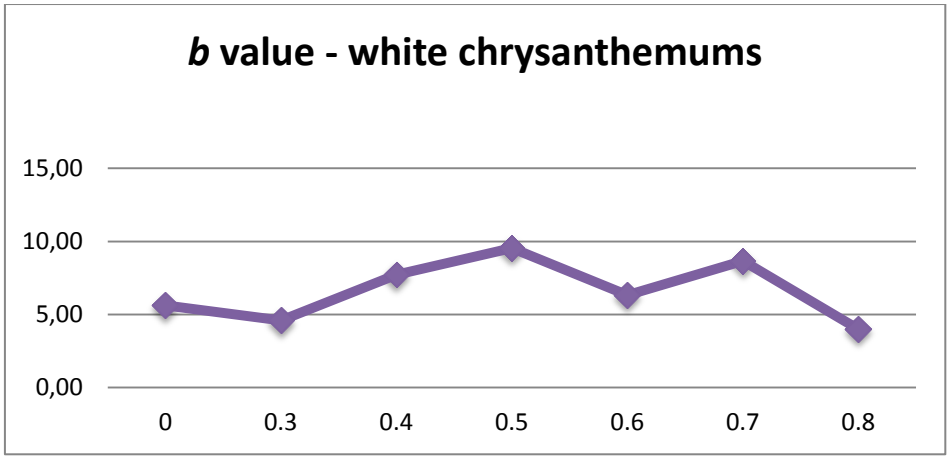

Figure 7. *b* Parameter of white chrysanthemums at different doses (mean values)

3.3 Colorimetric analysis: red chrysanthemums

The color analyses for of white chrysanthemums are shown in Figures 8, 9 and 10. Observe in Figure 8 that L* parameter did not show a statiscal difference between non-irradiated and irradiated.

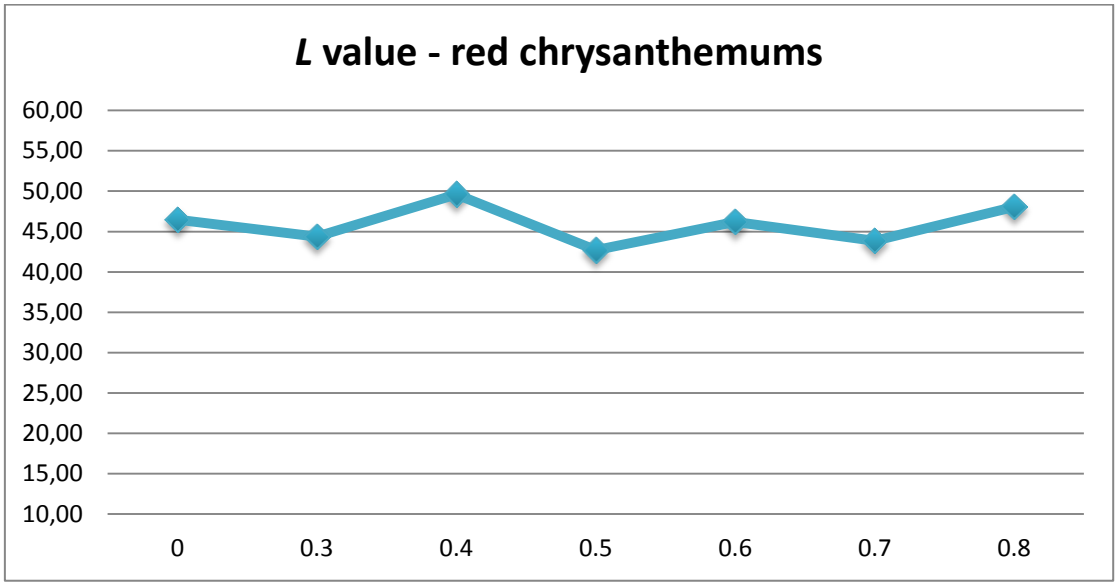

Figure 8. *L* Parameter (brightness) of red chrysanthemums at different doses (mean values)

Figure 9, the a* parameter (+ red; - green) showed that the irradiated sample starting 0.5 kGy differ significantly of non-irradiated samples, while the samples processed with 0.3 and 0.4 kGy remained with the same characteristics of the control sample.

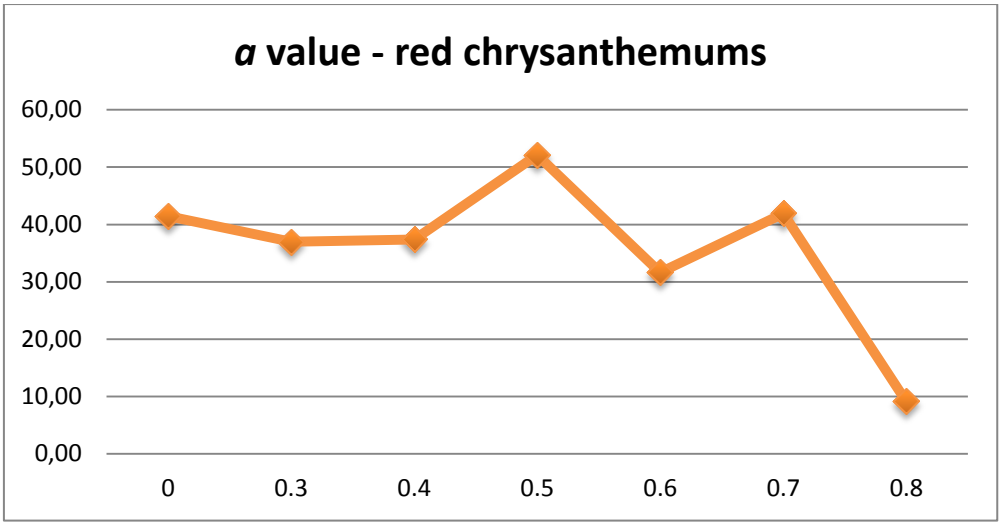

Figure 9. *a* Parameter of redchrysanthemums at different doses (mean values)

The b* parameter (Figure 10) showed that the irradiated sample 0.8 kGy differ significantly of non-irradiated samples, while the samples processed with 0.3 to 0.7 kGy remained with the same characteristics of the control sample.

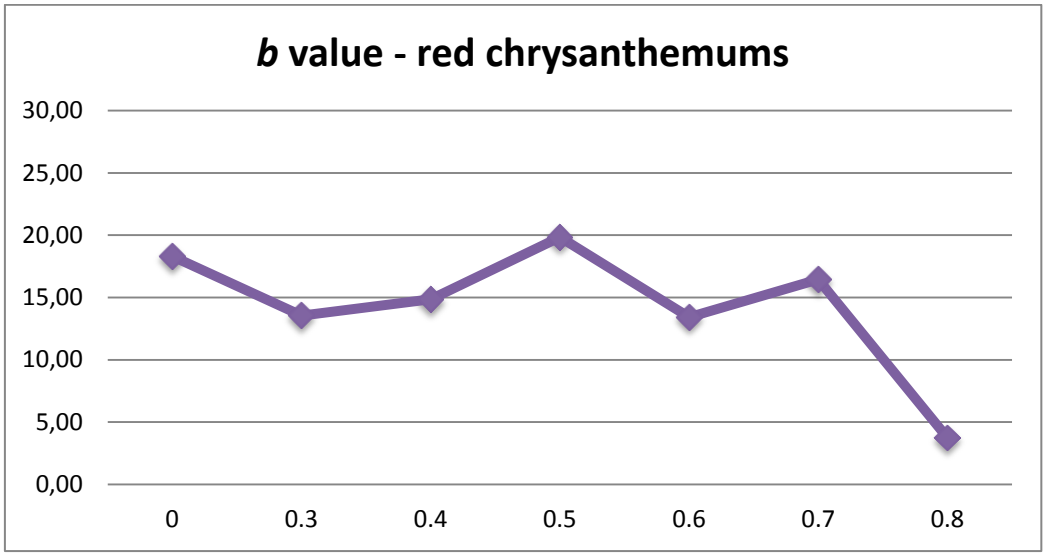

Figure 10. *b* Parameter of red chrysanthemums at different doses (mean values)

4. CONCLUSIONS

Color is an important quality attribute of edible flowers, from the color analysis results showed a significant change on samples irradiated with 0.5 and 0.8kGy, to dose of 0.3 kGy it is necessary to sterilize insects.

ACKNOWLEDGMENTS

We are thankful to CNEN, CNPq and IPEN-CNEN/SP for financial support.

REFERENCES

1. R. Creasy, *The Edible Flowers Garden*. Periplus Editions, Boston (1999).
2. J. Mlcek, O. Rop. Fresh edible flowers of ornamental plants - A new source of nutraceutical foods, *Trends in Food Science & Technology*, **Vol. 22**, PP. 561-569 (2011).
3. K. M. Kelley, A.C. Cameron, J. A Biernbaum, K.L. Poff, Consumer Ratings of Edible Flo wer Quality, Mix And Color, *Horttechnology,* **Vol. 11**, pp. 644-647 (2001).
4. O. Rop, J. Mlcek, T. Jurikova, J. Neugebauerova, J. Vabkova, Edible Flowers—A New Promising Source of Mineral Elements in Human Nutrition, *Molecules*, **Vol. 17**, pp. 6672-6683 (2012).
5. S. E. Newnam, A. S. O'Conner, Edible Flowers. *CSU Extension*; n. 7237. pp. 1-5 (2009).
6. G. Felippe, *Entre o jardim e a horta*, Editora Senac, São Paulo (2004).
7. V. Komolprasert, Packaging for Foods Treated by Ionizing Radiation, In *Packaging for Nonthermal Processing of Food*, edited by Jung H. Han, IFT Press: Blackwell Publishing, pp. 87-116, (2007).
8. J. Farkas, C.M. Farkas, History And Future Of Food Irradiation, *Trends in Food Science & Technology*, **Vol. 22**, pp. 121-126 (2009).
9. G.L. Tritsch, Food irradiation, *Nutrition*, **Vol. 16**, pp. 698–718 (2000).
10. K.M. Morehouse, Food irradiation-US regulatory considerations, *Radiation Physics and Chemistry*, **Vol. 63**, pp.281-284 (2002).
11. Farkas, J., Irradiation For Better Foods, *Trends in Food Science & Technology*, **Vol. 18**, pp.1-5 (2006).
12. O. K. Kikuchi, N.L. del Mastro, F.M. Wiendl, Preservative Solution For Gamma Irradiated Chrysanthemum Cut Flowers. *Radiation Physicsan Chemestry*. **Vol. 46**, pp. 1309-1311 (1995).
13. O. K. Kikuchi, Orchid Flowers Tolerance To Gamma Radiation. *Radiation Physicsan Chemestry*. **Vol. 57**, pp. 555-557 (2000).
14. D.B. Macdougall, *Color in food: improving quality*, Boca Raton, New York (2002).
15. Della Modesta, R. C. *Análise sensorial de alimentos e bebidas*. Rio de Janeiro: EMBRAPA, 1989. 120p.
16. P.V.Silva, T.C.F. Nunes, C.Furgeri, R.N.M Pitombo, K.Y. Hojeije, A.L.C.H. Villavicencio. E-beam Irradiation of "in nature" Palm: Texture and Color Evaluation, In: IAEA *International Topical Meeting on Nuclear Research Applications and Utilization of Accelerators*, Viena: 4-8 May ,(2009)