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Sensory properties of macaroni with and without green banana pulp and the application of ^{60}Cobalt Ionizing Radiation

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Abstract

The green banana flour or green banana is a complex–carbohydrate source (mainly as resistant starch), minerals, vitamins and fiber. It is important to take into account the sensory properties in the use of ready- to -eat foods like macaroni, among others. Gamma irradiation is considered an alternative method for food preservation. The aim of this study was to compare the influence of flour type, flour irradiation treatment and cooking time on the physical, chemical and sensory properties of macaroni noodles. To discover the differences between the noodles, two cooking times (6 and 10 min in boiling water) were used in order to study their extensibility and point of rupture. The rheological properties were determined with a tensile strength module coupled to the TA-HD*i* texture analyzer. The moisture and protein contents were also analyzed. In addition, acceptation tests of the three different types of macaroni cooked at different times were performed. The irradiation of banana noodles was performed in a ^{60}Co. The normal wheat samples presented significantly higher values for extensibility than the banana samples ($P < 0.05$). The protein values of samples ranged between 4 – 6% (m/m), but the differences among all the samples were not significant ($P > 0.05$). The sensory evaluation of samples showed that the samples of 10 min cooking were preferred than samples of 6 min cooking. The banana macaroni noodles showed a lower extensibility and lower protein content (without eggs) than normal pasta, being this one the sensorially preferred. Concerning cooking times, it was found that the tasters preferred the macaroni noodles cooked 10 minutes. For protein no significant difference ($P > 0.05$) were found among all the macaroni.

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Keywords: sensory properties, green banana, irradiation

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1. Introduction

The green banana flour or green banana is a complex carbohydrates source, mainly of resistant starch, and also of minerals, vitamins, fiber and it is an important functional food [1, 2]. In general, flour prepared from unpeeled banana was found to show enhanced nutrition values with higher content of mineral, dietary fiber and total phenolics. Hence, flour fortified with peel showed relatively higher antioxidant activity [3]. Green banana diet improves clinical severity in childhood shigellosis and could be a simple and useful adjunct for dietary management of this illness [4]. So, it is important the usefulness (pulp, peel and flour) from green banana in the ready to eat foods.

Food irradiation has been identified as a safe and alternative technology of food preservation and to reduce the risk of foodborne illness as part of high-quality food production, processing, handling, and preparation. The process has been approved by more than 40 countries around the world. The technology utilizes a source of ionizing energy that passes through food to destroy harmful bacteria and other organisms. Often it is referred to as "cold pasteurization ". Food irradiation offers negligible loss of nutrients or sensory qualities [5].

The need to eliminate bacterial pathogens from ready-to-eat food products such as macaroni and bread, among others, must always be balanced with the maintenance of product quality. In addition to determining the effective ionizing radiation doses required for pathogen elimination, the effects of irradiation on product chemistry, nutritional value and sensory quality must also be determined [6].

A study on the sensory properties of the yellow noodle prepared from 30% green banana flour with addition of 10% oat beta-glucan showed that the substitution of wheat flour with green banana resulted in significantly higher total dietary fiber. Sensory evaluation indicated that the quality of the green banana flour was comparable to that of the control [7]. The author reported that consumers consistently rated irradiated fruit as equal to, or better than, non-irradiated fruits in appearance, freshness, and taste. However, irradiation may affect the sensory properties, depending on the irradiation dose, temperature, packaging and atmosphere during irradiation [5].

The aim of this study was to compare the influence of flour type, flour irradiation and cooking time on the physical, chemical and sensory properties of macaroni noodles.

2. Materials & Methods

From banana flour non-irradiated (control) and from the same flour but irradiated, two types of macaroni noodle samples were prepared: samples of control banana noodles (CR) and samples of irradiated banana noodles (IR), respectively. In addition, it was bought a wheat commercial macaroni noodle which was designated normal sample (N). To find the differences between the noodles, two cooking times in boiling water were used: 6 and 10 min.

Irradiation was performed in a ^{60}Co Gammacell 220 (AECL) source, dose rate about 2.16 kGy/h at dose 3 kGy, dose uniformity factor, 1.13. Dosimetric mapping was previously performed by Fricke dosimetry.

The rheological properties were determined with a tensile strength module coupled to the TA-HD*i* texture analyzer, being the noodles stretched applying a constant strain to find the force in point of rupture (extensibility, N). The moisture and protein contents were also analyzed [8]. In addition, acceptation tests of the three different types of macaroni cooked at different times were performed by 20 panellists using a sensory structured hedonic scale; the parameters evaluated were appearance, hardness, elasticity and smell.

The average and standard deviation values were determined. Experimental data were subjected to One-way ANOVA (pairwise comparison of means with Scheffé test). The level of significance, chosen for variable selection, was 0.05. Data were analysed using STATISTICA 6.0 (StatSoft, Tulsa, USA).

3. Results & Discussion

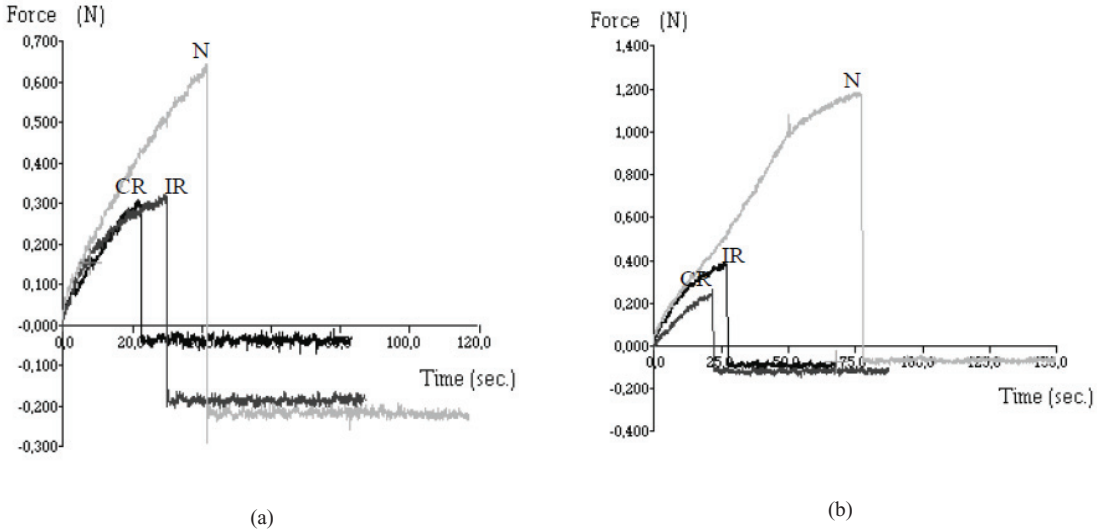
The Table 1 shows the results of extensibility, protein and moisture of different type of macaroni samples.

Table 1. Results of extensibility, protein and moisture of macaroni (mean values, standard deviation and ANOVA coefficients)

Macaroni	Extensibility N	Protein % m/m	Moisture % m/m
Normal / 6 min	0.792 (0.003)[b]	6.28 (0.014)[c]	57.67 (0.792)[c]
Normal / 10 min	1.064 (0.005)[a]	5.21 (0.001)[c]	65.51 (1.064)[a]
Control banana / 6 min	0.327 (0.007)[c]	5.73 (0.001)[c]	57.44 (0.327)c
Control banana / 10 min	0.433 (0.024)[c]	5.17 (0.005)[c]	65.94 (0.433)[a]
Irradiated banana / 6 min	0.351 (0.018)[c]	5.65 (0.001)[c]	60.25 (0.351)[bc]
Irradiated banana / 10 min	0.274 (0.003)[c]	4.40 (0.010)[c]	64.69 (0.274)[a]

[a,b,c,] . . .Means in the same column marked with different letters are significantly different

The normal wheat samples presented significantly higher values for extensibility than the banana samples ($P < 0.05$). The protein values of samples ranged between 4 – 6% (m/m), but the differences among all the samples (normal, control banana an irradiated macaroni) were not significant ($P > 0.05$). The moisture content of 10 minutes cooked samples was significantly superior to the moisture of 5 min cooked samples ($P < 0.05$). To understand the influence of moisture in extensibility, the Figure 1 shows the tensile strength texture profile for the various samples.



(a) (b)

Fig. 1. Tensile strength texture profile for normal noodles samples (N), control banana noodles samples (CR) and irradiated noodles samples (IR) cooked in boiling water during 6 min (a) and 10 min (b)

In the tensile strength texture profile of samples, it is possible to observe that the 10 min cooked samples showed a superior rupture time than the 6 min cooked samples. This means that those samples, with higher moisture content, exhibited higher values of distance to rupture. The sensory evaluation of

samples showed that the samples of 10 minutes cooking time were preferred to samples of 6 minutes cooking time, for all kind of macaroni. In addition, the banana control samples presented a higher sensory score than irradiation samples (Figure 2). But with respect to global appreciation, the banana noodles (CR) and irradiated samples (IR) (Figure 2 b) scored (6) and (5), respectively.

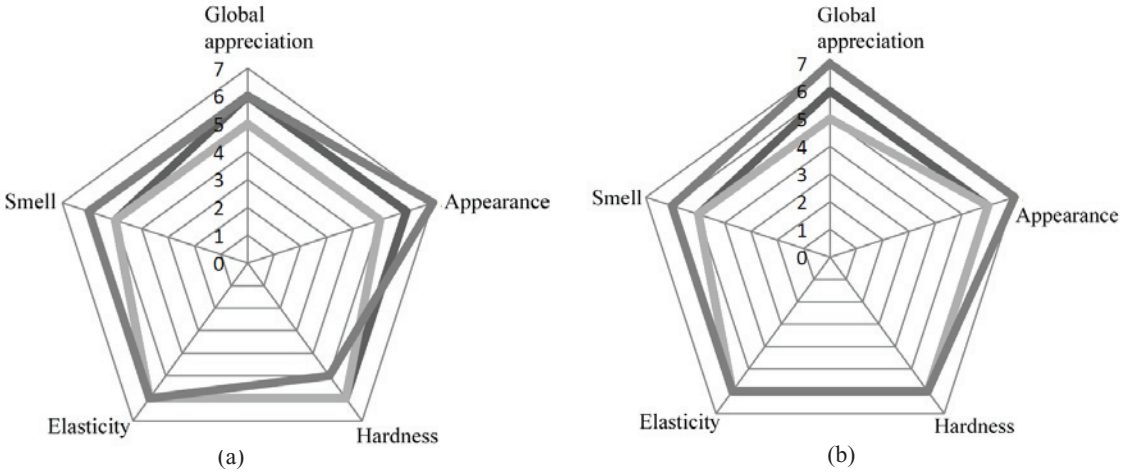


Fig. 2. Sensory results for normal noodles samples ( ), Control banana noodles samples ( )and irradiated noodles samples ( ) cooked in boiling water during 6 min (a) and 10 min (b)

4. Conclusion

The banana macaroni noodles have a lower extensibility and lower protein content (without eggs) than normal pasta, being this one the sensorially preferred. Concerning cooking times, it was found that the tasters preferred the macaroni noodles cooked for 10 min, and at this cooking time, all kinds of noodles in the study showed greater extensibility. For protein no significant difference ($P > 0.05$) were found among all the macaroni.

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