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Effect of irradiation on Brazilian honeys' consistency and their acceptability

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Abstract

Contamination of bee products may occur during packing or even during the process of collection. Gamma irradiation was found to decrease the number of bacteria and fungi. However, little information is available on the effects of gamma irradiation on viscosity which is an important property of honey. In this work the viscosity of two varieties of Brazilian honey was measured when they were irradiated at 5 and 10 kGy. The viscosity was measured at four temperatures (25°C, 30°C, 35°C and 40°C) for both samples and compared with control and within the doses. The sensory evaluation was carried on for the parameters color, odor, taste and consistency, using a 9-point hedonic scale. All the data were treated with a statistical tool (Statistica 5.1, StatSoft, 1998). The viscosity was not impaired significantly by gamma irradiation in doses 5 and 10 kGy ($p<0.05$). The effect of gamma irradiation on sensorial characteristics (odor, color, taste and consistency) is presented. The taste for Parana type indicated a significant difference among irradiation doses ($p<0.05$) but the higher value was for 5 kGy dose, demonstrating the acceptability for this case. The Organic honey presented the taste parameter for 10 kGy, significantly lower than the control mean but it did not differ significantly from the 5 kGy value.

Keywords: Viscometer; Honey; Gamma irradiation; Sensorial evaluation

1. Introduction

Honey is nectar, constituted essentially of sugar syrup. The main sugars in honey are monosaccharides—fructose and glucose—which sum up to 70%. Dissacharides, including saccharose, are around 10% and water, where sugars are dissolved is approximately 20%. The exact composition of honey depends on the region, mainly the botanicals, from where they are derived (Felsner, 2001). Viscosity is one of the important properties of honey and depends on water and sugar quantities. Viscosity characteristics can be governed by the molecular chain length of sugars present in the honey (Bhandari et al., 1999). Temperature has also a significant role on the viscosity of honey.

Honey is used in condiments, salad dressing, barbecue sauce and peanut butter. Dairy, meat, beverage, snack and candy manufacturers also use honey as an ingredient. Honey is a product that is free of most microbes and those microbes that may be present are likely to be in very low numbers. The use of honey in products that receive no or limited heat treatment may require additional tests besides total plate count (Snowdon and Cliver, 1996). From commercial point of view, microbiological contamination of bee products has become interesting because of legislative aspects (Fleche et al., 1997). The gamma irradiation process seems to be a good alternative to pasteurization as it avoids heating. Gamma radiation applied on seven honey samples was found to decrease the amount of aerobic and anaerobic bacteria and fungi (Migdal et al., 2000).

However, there is little information in literature about the effect of radiation on the viscosity of honey. This

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current work has aimed to verify the changes on viscosity measurements in two types of Brazilian honey. The samples were irradiated at 5 and 10 kGy and the viscosity was measured at different temperatures. The acceptability of irradiated honey was evaluated in a sensorial test.

2. Experimental

2.1. Materials

The conventional honey-type Parana was from Parana region and honey-type Organic was from São Paulo region, both were kindly supplied by MNS PRÓPOLIS enterprise. The composition of a typical batch was: water content: 18.5%, saccharose content: 0.96%, reduced sugars: 70.62%, HMF content: 2.7 mg/Kg.

2.2. Irradiation

The samples were irradiated in closed flasks containing 1 kg each, in normal atmosphere and at room temperature. Irradiation was performed in a ^{60}Co Gammacell 220 (AECL), at a mean dose rate of 5.53 kGy/h and dose uniformity factor of 1.13, with doses of 0, 5 and 10 kGy.

Dosimetry was done using Amber routine dosimeter (Harwell, UK) and dose rate was established using Fricke reference dosimeter to plot calibration curves. The whole dosimetry system is in IDAS program from the International Atomic Energy Agency.

2.3. Viscosimetry

Viscosity measurements were carried out using a Brookfield viscometer, model LV-DVIII, spindle SC4-34, as described previously (Sabato and Lacroix, 2002), at different temperatures, 25°C, 30°C, 35°C and 40°C (±0.1°C), employing a Neslab water bath. The measurements for both types of honey were done at a shear rate of 1.40 seg^{-1} (5 rpm).

For each measurement, three replicates were carried out, on different days. The set of data from the whole experimental design was submitted to a statistical analysis, consisting of an F-test between treatments and Anova among all data (Statistica 5.1, StatSoft, 1998).

2.4. Sensorial evaluation

The sensorial evaluation was performed by untrained panel lists ($n=34$ for Organic and $n=51$ for Parana, students and employees of CTR-IPEN, São Paulo, Brazil). A 9-point hedonic scale was employed ranging from 1 (most disliked) to 9 (most liked), for the parameters color, odor, taste and consistency (Carpenter et al., 2000; ASTM, 1973).

3. Results and discussion

For both honeys samples the viscosity values were affected significantly at temperatures 25°C, 30°C and 35°C ($p<0.05$) (Organic and Parana) as can be observed in Tables 1 and 2. The viscosity values measured at 40°C presented lower level values than those at other temperatures for both types of honey, but they were not significantly different ($p<0.05$). This behavior was verified by Munro (1943), who showed lower temperatures have the greatest effects on viscosity in contrast with heating honey above 30°C, the effect being of little practical importance.

On the other hand, gamma irradiation did not impair the viscosity in the studied doses (5 and 10 kGy) and they did not differ significantly from the control ($p<0.05$) for both types of honey.

The sensorial evaluation, presented in Tables 3 and 4 (Parana and Organic types, respectively) showed a significant difference for some parameters due to irradiation doses.

Table 1
Averages and standard deviation of viscosity values for the honey-type Parana in function of irradiation doses and measured at four levels of temperature

Temperature(°C)	Viscosity (cP)		
	Irradiation doses		
	0 kGy	5 kGy	10 kGy
25	11,151±592 (a)	9457±1991 (a)	12,120±1592 (a)
30	6412±510 (b)	5849±1157 (b)	6939±1815 (b)
35	3849±239 (c)	3594±397 (c)	4112±579 (c)
40	2433±211 (c)	2229±526 (c)	2530±428 (c)

Mean values followed by different letters in the same column are significantly different ($p<0.05$).

The color of Parana honey in 10 kGy dose showed a lower mean compared to control and 5 kGy dose ($p<0.05$) (Table 3). The taste parameter of this honey also indicated a significant difference among irradiation doses ($p<0.05$) but the higher value was for 5 kGy dose, demonstrating the acceptability for this case. Odor and consistency did not show any significant difference ($p<0.05$).

The Organic honey presented the taste parameter for 10 kGy as significantly lower than the control mean but it did not differ significantly from the 5 kGy value (Table 4). The color parameter of this honey presented no significant differences on irradiation. Odor and consistency did not show any significant difference ($p<0.05$).

The mean values on the hedonic scale ranged from 5.35 to 7.00 for Parana sample and 6.53 to 7.85 for Organic honey. These results indicate acceptability from the average to above average. The results obtained in other work evolving irradiated honey showed the same trend, where the color, taste and smell of this sensorial evaluation performed in the three honey samples that were irradiated at 10 kGy remained unchanged when compared to unirradiated pairs (Migdal, 2000).

4. Conclusion

The viscosity measurements for both varieties of Brazilian honey were not impaired by gamma irradiation treatment in the doses studied (up to 10 kGy). In general, the acceptability of sensorial characteristics was favorable for irradiated honeys. The taste was significantly affected ($p<0.05$) in both the honey samples but in opposite ways: for Parana, the higher value was for 5 kGy while for Organic the higher mean was for control. The latter was not significantly different from

Table 2
Averages and standard deviation of viscosity values for honey-type Organic in function of irradiation doses and measured at four levels of temperature

Temperature(°C)	Viscosity (cP)		
	Irradiation doses		
	0 kGy	5 kGy	10 kGy
25	9112±1333 (a)	9258±1240 (a)	8236±922 (a)
30	5427±385 (b)	4949±405 (b)	4641±576 (b)
35	2544±245 (c)	2772±183 (c)	2635±235 (c)
40	1992±180 (c)	1787±139 (c)	1743±208 (c)

Mean values followed by different letters in the same column are significantly different ($p<0.05$).

Table 3
Mean and standard deviation of the parameters for the sensorial evaluation of honey-type Parana

	Color	Odor	Taste	Consistency
Control	6.65±1.52 (a)	6.31±1.74 (a)	6.75±1.64 (ab)	6.22±1.81 (a)
Dose 5 kGy	6.57±1.70 (a)	6.24±1.73 (a)	7.00±1.60 (a)	6.43±1.79 (a)
Dose 10 kGy	5.35±1.88 (b)	5.98±1.61 (a)	6.33±1.95 (b)	5.98±1.91 (a)

Mean values followed by different letters in the same column are significantly different ($p<0.05$).

Table 4
Mean and standard deviation of the parameters for the sensorial evaluation of honey-type Organic

	Color	Odor	Taste	Consistency
Control	7.24±1.72 (a)	7.09±1.58 (a)	7.53±1.66 (a)	7.85±1.28 (a)
Dose 5 kGy	7.38±1.63 (a)	7.18±1.49 (a)	7.18±1.59 (ab)	7.44±1.67 (a)
Dose 10 kGy	7.47±1.35 (a)	6.79±1.51 (a)	6.53±2.21 (b)	7.59±1.62 (a)

Mean values followed by different letters in the same column are significantly different ($p<0.05$).

5 kGy but differed significantly from 10 kGy and 10 kGy did not differ significantly from 5 kGy.

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