

Utilization of some plant oils in production of butter substitutes and keeping their quality by gamma irradiation

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of this investigation was to study the possibility of using a blend of RBD palm oil and RBD stearin for production of butter substitute free from cholesterol and trans fatty acids (formed due to hydrogenation of oils which is used for production of butter substitutes or margarin) by blending, and to study the possibility of using safe gamma irradiation doses for keeping the quality of the product in comparison to the use of sodium benzoate as a preservative. Two parts of butter substitute samples were prepared. Samples of the first part consisted of 58.31% RBD palm oil, 24.91% RBD stearin, 0.25% emulsifier, 12.4% boiled water, 2.4% dried skim milk, 1.5% sodium chloride, 0.3% sodium benzoate, 100 ppm of antioxidant (T.B.H.Q.) and butter flavour 2 mV/kg. While samples of the second part were prepared from the same constituents without the addition of sodium benzoate. Then, samples of the second part were exposed to gamma irradiation at doses of 2, 4, 6 and 8 kGy (except some samples to serve as control samples). All samples were stored at both ambient and refrigerator temperatures. Attention was focused on the changes occurring in physical and chemical properties, fatty acid composition and saponifiable matter composition as a result of either gamma irradiation or the addition of sodium benzoate. In addition, the effects of these treatments on microbiological aspects by the determination of total counts of bacteria and fungi. Moreover, the effect of these treatments on the organoleptic properties of the product was studied by the evaluation of sensory properties as appearance and colour and odour of samples at zero time and during storage for 60 days at ambient and refrigerator temperatures. The results can be summarized as follows:

- 1.1- The results of physico-chemical determinations showed the quality of palm oil and palm stearin used in preparation of the product; they had a melting point of 33 and 44°C, respectively. While, the acid value was 0.18 and 0.22 and the peroxide value was 0.35 and 0.42 g for both palm oil and palm stearin, respectively.
- 1.2- The results of physico-chemical determinations also indicated the good physical and chemical properties for the product, the melting point was 5°C, while the acid and peroxide values were 0.245 and 0.45.
- 1.3- The acid value of samples containing sodium benzoate did not change and it was 0.23, meanwhile, a slight gradual increase in the acid value was observed in the irradiated samples with the increase of gamma irradiation dose; thus it increased from 0.24 in the control sample to 0.28, 0.30, 0.33 and 0.36 in samples exposed to 2, 4, 6 and 8 kGy, respectively. In addition, the acid value showed a gradual increase in all samples during storage, but the rate of increase was lower in cold storage than in storage at the ambient temperature.
- 1.4- The peroxide value of samples containing sodium benzoate was not altered compared to the control sample, while gamma irradiation treatments caused a slight gradual increase in the peroxide value as it increased from 0.45 meq/kg in the control sample to 0.94, 1.38, 1.6 and 1.76 eq/kg in samples irradiated at 2, 4, 6 and 8 kGy, respectively. Moreover, storage of samples either at ambient or at refrigerator temperature gradually increased the peroxide value in all treatments till 30 days of storage then, started to decrease gradually.
- 1.5- Thiobarbituric acid (TBA) showed no changes as a result of addition of sodium benzoate compared to the control sample. Meanwhile a very slight increase was observed in the TBA due to irradiation treatments. During storage, there was a gradual increase in the TBA values in all samples at both temperatures.
- 1.6- The concentration of 100 ppm T.B.H.Q. was the best one among tested

concentrations (0.0, 50, 100, 150 and 200 ppm) respectively. p-sitosterol was the major sterol among sterol compounds reaching 28.86%. Gamma irradiation at 6 kGy did not cause detectable change in the total hydrocarbons, total tocopherols and total sterols as compounds amounted to 15.52, 30.62 and 53.85 %, respectively, in the irradiated samples.

2- Microbiological analysis:-

2.1- The untreated butter substitute samples (control) had a high microbial load as the total bacterial and total mold counts were 3.2×10^5 and 2.5×10^2 cfu/g, respectively.

2.2- The control samples spoiled after 15 and 30 days of storage at ambient and refrigerator temperature, respectively, as indicated by mold growth as well as the increase in both total bacterial and mold counts.

2.3- The addition of sodium benzoate prevented the growth of bacteria and molds in samples up to only 30 and 45 days of storage at ambient and refrigerator temperature, respectively.

2.4- Irradiation doses of 2 and 4 kGy were not sufficient for keeping the microbiological quality of the product during storage since samples subjected to 2 kGy spoiled after 30 days of storage in both cases. While samples irradiated at 4 kGy spoiled after 30 and 45 days of storage.

2.5- Gamma irradiation doses of 6 and 8 kGy were sufficient and effective for keeping the microbiological quality of the product all over the storage period under investigation (60 days) at both temperatures indicating that 6 kGy dose was effective for keeping the product quality without the need for cold storage.

3- Sensory evaluation:- showed that there were no detectable changes in general appearance and colour of butter substitute samples at any time due to neither adding sodium benzoate nor treatment by gamma irradiation. Although the original colour of the product did not alter during storage, the control samples were rejected because of the visual viewing of mold growth after 15 and 30 days of storage at ambient and refrigerator temperature, respectively. Samples containing sodium benzoate were also rejected after 45 and 60 days of storage at both temperatures, respectively. In addition, samples irradiated at 2 kGy were rejected for the same reason after 30 days of storage at both temperatures, while samples subjected to 4 kGy dose were rejected after 30 and 45 days.

3.2- Butter substitute samples irradiated at 6 and 8 kGy dose kept their sensory quality for general appearance and colour all over the storage period.

3.3- Sensory evaluation also indicated that the odour of butter substitute samples did not change as a result of adding sodium benzoate or irradiation treatments at the zero time. During storage, no rancid odour was detected, but moldy odour was detected in the samples which were rejected because of the presence of mold growth (control, samples containing sodium benzoate, samples irradiated at 2 and 4 kGy doses). In addition, samples irradiated at 6 and 8 kGy kept their odour quality all over the storage period either at ambient or refrigerator temperature.