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IRRADIATION EFFECT ON PEROXIDATION INDEX ON OKARA-BASED SOYBEAN FLOUR

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ABSTRACT

Soya seasoned flour (SSF), also known as "farofa", is an industrialized product, low cost, easy to make and can be enriched in order to provide a food with greater nutritional and functional value. In this regard, "okara" (inert flavored mass obtained as a residue from the soybean extract), is a viable alternative for nutritional enrichment in relation to conventional maize and manioc tempered flours and ionizing radiation process increases its conservation. The present work aimed to use the SSF based "okara", as a way to reuse a by-product of soybean processing and analyzing the possible effect of gamma irradiation at doses of 1 and 3 kGy, in the analysis of determination of lipid peroxidation. The preparation of SSF containing "*okara",* dehydrated condiments and flavor uplifting was held at FATEC Marília. SSF samples were processed at "Centro de Energia Nuclear na Agricultura (CENA)", University of Piracicaba-SP, irradiated with doses of 1 and 3 KGy in ^{60}Co source. The dose rate was 0.269/hs. Analyses were performed to determine the peroxide index of control samples and irradiated in triplicate in 1, 15, 30 and 45 storage days in accordance with methodology for oils and fats with modifications. Using this peroxides methodology, it wasn't possible to detect changes in oxidative quality in SSF samples, within 45 days of storage, with the parameter that the flour showed 29.92% of lipids. We conclude that this product with excellent nutritional attributes about the commercial flour, we must apply a different methodology to detect any radiation damage on lipid compounds.

1. INTRODUCTION

The seasoned flour also called "farofa" is an industrialized product, low cost, easy preparation and can be enriched in order to provide a food with higher nutritional and functional value. In this aspect, the "*okara",* inert flavor mass purchased as residue from the production of soy extract, constitutes a viable alternative nutritional enrichment in relation to seasoned corn and manioc flour, highlighting the high protein content in the soy flour base "okara" [1].

In this context the irradiation technology presents a viable alternative for preserving food, ~~is~~ to avoid food spoilage, insect infestation or food borne diseases [2]. It consists of a treatment by means of a type of ionizing energy (gamma radiation, x-rays and electron beam) with electromagnetic waves emitted from excited nuclei of elements such as ^{60}Co, ^{137}Cs and/or electron accelerators in food packed or not [3]. This Technology presents an advantage, as it allows the reduction of the use of chemicals products, used as preservative and antibiotic in foods [4].

The use of the ionizing irradiation process in lipid-rich foods is linked to the breakdown of fatty acid chains present in the food constituents giving rise to the unique radical products formed solely by radiation in the oxidation of lipids [5]. The changes will depend on the composition of the food, the water content, the radiation dose, the temperature and the presence or absence of oxygen in the process [6, 7].

The present work aimed to use the okara SSF as a way to reuse a by-product of soy bean processing and analyzing the possible effect of gamma irradiation at doses of 1 and 3 kGy, in the analysis of determination of lipid peroxidation.

1.1. Lipid oxidations and irradiation.

Lipid oxidation is related as indicative of the nutritional and sensorial quality of the food, and is considered the main cause of food spoilage during storage, once storage is an important phase of the production chain, as it guarantees quality and minimizes losses [8]. Incorrect storage of high-lipid foods is due to the appearance of aldehydes, ketones, hydrocarbons, ethers, furans and lactones responsible for rancidity and undesirable taste, this interaction consists of a reaction with present oxygen [9, 10].

The use of antioxidant substances has an effect of isolating or preventing the formation of free radicals in food, with the purpose of delaying or preventing the appearance of oxidative alterations, they may be natural or synthetic, the natural ones are vegetable, artificial synthetics such as BHT (Butylhydroxytoluene), BHA (Butylhydroxyanisole), TBHQ (Terc-butylhydroquinone), PG (Propylgalate) which are the most used in the food industries because they have excellent stability and low cost [11,12,13]. However the use of artificial antioxidants promotes toxicological effects in the organism, seen in animal studies the presence of toxicity in the kidneys, liver, in addition to the reduction of weight gain, as a way to replace it and minimize / inhibit the appearance of lipid oxidation is employed the irradiation technology, with low doses [10, 14].

Irradiation technology involves the exposure of a food to a specific dose of ionizing radiation [11]. The low doses showed to be effective as in any other method of food conversation, since the use of high doses has the effect of compromising the lipid-rich foods, promoting side effects, resulting in small breaks in the chains, releasing sulphurous smell and unpleasant taste [15]. This effect accelerates the lipid oxidation process in stored foods [9, 16].

Ionizing radiation can act directly and indirectly. Direct action occurs when the radiation directly reaches a chemical bond of the constituent of the food. The indirect is from an ionization of another molecule, such as water that can form free radicals that interacted with the food component [17]. The effects of ionizing radiation on lipid fraction consist of pathways strongly influenced by structure molecules, since they are the first excited when absorbed by radiation. The breakdowns of the triglyceride molecules will occur in the carbonyl group at position five occasionally, at all carbon-carbon bonds remaining in the fatty acid. In the case of saturated fats presents a link to oxygen compounds, causing a deficiency in electrons, directing the location of breaks for the next grouping carboxyl. Can occur by interaction of radiolytic reaction resulting in unsaturation of glycerides molecule [11, 18]

2. MATERIALS AND METHODS

The "okara" was obtained following the methodology explained Viana, Bueno e Góes-Favoni (2011) [19], with modifications, held at FATEC Marília. After obtaining the "*okara"* was submitted to drying. Then made preliminary tests, the SSF was drafted containing the "*okara"* dehydrated, dehydrated seasonings and flavor enhancers. After cooling to ambient temperature, the SSF was wrapped in polypropylene bags coated with aluminum foil, with 500 g each. SSF samples were submitted to irradiation treatment at the "Centro de Energia Nuclear na Agricultura (CENA)", University of Piracicaba-SP. The doses of 1kGy and 3 kGy was made in a ^{60}Co source with 0.269/hs rate. Analyses were performed to determine the peroxide content of control samples (no irradiated) and irradiated in triplicate in 1, 15, 30, 45 days storage according to the methodology described by Instituto Adolfo Lutz (2008) [20], with modifications for oils and fats as described by Broca ; Devidé (2013)[21].

Initially were homogenized 5g of the sample, in an erlenmeyer flask with a polished aluminum foil-covered, add 30 mL of acetic acid solution-chloroform (3:2), and later shaking on the shaker table (Marconi agitator mod. Ma. 140), for 30 minutes. Then it was added to the erlenmeyer 0.5 mL flask of a saturated solution of potassium iodide and this kept at rest under light, for 5 minutes. Added 30 mL of distilled water and the content was filtered at vacuum. Added 1 ml of starch solution 1% when filtered and titrated with sodium thiosulphate solution 0,01N with constant agitation. So calculated the peroxide with the words below:

$$\frac{(A-B)\, x\, N\, x\, f\, x\, 1000}{P} = Peroxide\ index\ in\ meq\ by\ 1000g\ of\ the\ sample \quad (1)$$

A = number in mL of Thiosulphate Sodium solution 0.1 (or 0.01 N) spent in titration sample.

B = number in mL of Thiosulphate Sodium solution 0.1 (or 0.01 N) spent in blank titration.

N = normality of the Thiosulphate Sodium solution.

f = factor of Thiosulphate Sodium solution.

P = number in grams of the sample.

3. RESULTS AND DISCUSSION

As we could observe, the presence of peroxide was not found in any of the samples submitted to the different treatments during 45 days of storage (Table 1).

Table 1 – Peroxide index determined in the FST control (nonirradiated) and irradiated on 1kGy and 3kGy on 0, 15, 30 and 45 storage days.

Storage days				
Sample	0	15	30	45
Control	Absence	Absence	Absence	Absence
1kGy	Absence	Absence	Absence	Absence
3kGy	Absence	Absence	Absence	Absence

Source: Autors data

Samples of SSF have low fat moisture content (5.0%) maybe the used method was not appropriated to ensuring the oxidative stability of the SSF. Similar results were described by [8] that observed the oxidative stability of wheat flour and cornmeal after different irradiation doses of gamma radiation (3, 4, 5 and 6 kGy), in samples of wheat flour stored for 3 months and 6 months for cornmeal. In the same paper, sensorial result showed an evidence of the presence of peroxides during storage time, proving that even 6kGy radiation causing oxidative rancidity in products of low humidity, also described in the Brazilian legislation, in which the maximum allowed moisture to flour is 15% humidity [22].
The analysis of peroxide index, evaluates the oxidative rancidity resulting from auto-oxidation of unsaturated fats contained in the sample, which has as a result, the destruction of fat-soluble vitamins and essential fatty acids and formation of flavor and characteristic odor [23].

Silva, et. Al. (1999) [24] studied the methods to evaluate the degree of lipid oxidation and antioxidant capacity, where he showed the importance of the State of oxidation of evaluating fats and oils, which were described different methods (physical, chemical and physico-chemical) however no method to correlates of the perfect way with the organoleptic changes produced in the course of the oxidative reactions. [25] carried out in his recearch, according to the methodology for extraction by bligh & dyer of fat for the study of the effect of irradiation in the maturation of the special kind of yellow cheese could observe a very soon separation of fat, was determined by peroxide index [26].

Evaluation of oxidation determined by peroxide value that sorts the peroxides level over time and that the low level is not a guarantee of good oxidative stability classical methods used as dispensing is the peroxides (Iométrico Method of LEA) and (Colorimetric Method). They are empirical methods and depend on the weight of the sample, temperature, time, amount of peroxide present and reactivity. Since at work all these analysis are not sufficient to detect the damage of lipid compounds [24].

4. CONCLUSIONS

We conclude that in this product with excellent nutritional attributes about the commercial flour, we must apply a different methodology to detect to lipid peroxidation after irradiation process.

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