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Evaluation of Acrylamide Contents of Potato Crisps Sold in Iranian Markets

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ABSTRACT: Fried products derived from potato, particularly potato crisp have been widely included in food basket of the households in the recent years in Iran. Potato crisp, among other products, is of great importance and is considered as competitive products. This product is in the list of the food products with high acrylamide content. Therefore, due to the nutritional importance of this product and the fact that previous works have not been carried out regarding the quantity of acrylamide present in the potato crisp sold in Iranian market, the evaluation of the presence of this chemical compound in such product is vital and quite necessary. Seven typical potato crisps sold in the market (salty and in one shape) including five samples of the Iranian potato crisps (T1, T2, T3, T4, T5) and two samples of the foreign potato crisps (T6, T7) were randomly chosen and tested. Quantification of acrylamide was carried out by modern unit of LC-MS-MS. According to the results the highest quantity of acrylamide was found in the sample T1 (1456/67 µg/Kg) and the lowest quantity was in T7 (220 µg/Kg). Statistical analysis also showed that there was a significant difference between the potato crisps produced in Iran and abroad (p=0.0013). The results revealed that the quantity of acrylamide in the potato crisps produced in the foreign countries is less than those in the potato crisps produced in Iran.

Keywords: *Acrylamide, Coupled Liquid Chromatography Method, Iranian Markets, Millard Reaction, Mass Spectrophotometry, Nutritional parameters, Potato Crisps.*

Introduction

Potato crisps has been consumed as a salty snack for about 150 years and have held a high share of the market particularly among the young consumers (Farkas *et al*., 1996). The annual consumption rate of this product has been reported around 750,000 tons in Iran. Eating potato crisp might seem to be harmless, but recent research indicated that foods produced under high temperature frying and cooking procedures might accelerate the formation of acrylamide (WHO, 1994). Acrylamide, a chemical compound with the formula of C_3H_5NO known as iopak 2-propeneamide is a white odorless crystalline solid with a molecular weight of 71.08 g/mol, density of 1.13 g/cm and melting point of 84.5 °C. This compound is soluble in water, ethanol, ether, and chloroform and is incompatible with acids, alkalis, oxidation agents, iron, and iron salts. Acrylamide is turned into ammonium through a non-thermal process and produces carbon monoxide, carbon dioxide, and nitrogen oxides by a thermal analysis (Budavari *et al*., 1989). For the first time in 2002 the formation of acrylamide was reported during the process of heating carbohydrates such as monosaccharide with a nitrogen sources. This formation is similar to Millard reaction (Tareke *et al*., 2002). Further studies by several research groups suggested that the main way of producing acrylamide in heated food is Millard reaction between free amine groups of amino acids, particularly asparagines and carbonyl source

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such as reductant sugars (Tareke *et al*., 2002). Schiff base is the first compound to be produced by the reaction where finally oxazolhdin-5-one is formed. Decarboxylation of oxazolhdin-5-one in the room temperature forms azomethine that might produce compounds that after series of reactions and break downs will form acrylamide (Yaylayan *et al*., 2003). Studies concerned with the subject, revealed that most of analytical methods employed are not sensitive and accurate (Zhang and Zhang, 2005).

Therefore, the object of this research is to apply advanced methods based on LC-MS-MS to find the small quantities of acrylamide present in potato crisps sold in Iranian market.

Materials and Methods

Seven potato crisps including 2 potato crisps produced in foreign countries were purchased. All the samples were randomly bought from different centers. T1, T2, T3, T4, T5 samples were produced in Iran and T6 and T7 samples were produced in foreign countries. Each sample was first crushed and then coded and prepared in three 100-g boxes and transferred to Qualitatsfordrung Scientific Institute Lab. in Cologne, Germany. The quantity of acrylamide was measured by coupled liquid chromatography method with mass spectrophotometry (Le-Ms-Ms unit) after oil extraction (Boroushaki *et al*., 2010). All the chemicals used were supplied by Merck Company, Germany.

In this research work the quantity of acrylamide in the potato crisps sold in Iranian market has been evaluated. The results were quantified in triplicate order. In order to analyse the data, SAS 9.1 statistical software, MEANS procedure, was used. To describe quantitative specifications, descriptive statistics in addition to mean and standard deviation was used. T-test was used to compare mean content of acrylamide of potato crisps produced in Iran and in foreign countries. Statistical meaningful level of data were defined in two levels of $p<0.05$ and $p<0.01$. Statistical diagrams were drawn by Excel software.

Results and Discussion

Figure 1 shows the mean quantity of acrylamide present in seven potato crisps**.**

According to the results, T3, T4, T5, T6, T7 samples did not have significant differences ($p<0.01$)**.**

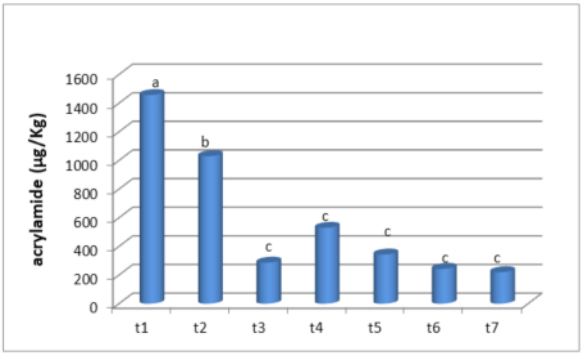

Fig. 1. Mean quantity of acrylamide (µg/Kg) in seven potato crisps ($p< 0.01$)

It was also revealed that the quantity of acrylamide in T1 sample of potato crisp (1456.67 µg/Kg) was higher than other examined samples. This might be due to many factors namely the temperature of processing as well as Maillard reaction procedure.

Figure 2 shows the mean quantity of acrylamide in seven potato crisps. According to the results, T3, T5, T6, T7 samples did not have significant differences ($p<0.05$).

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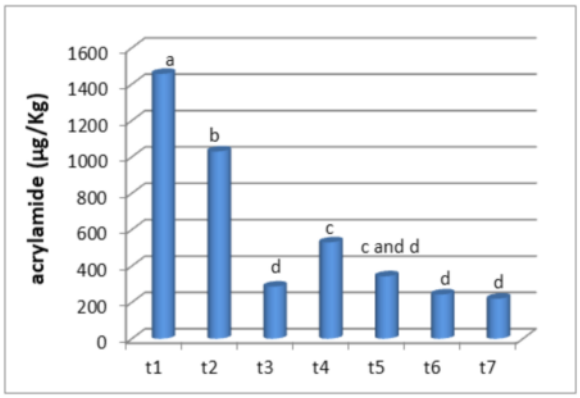

Fig. 2. Mean quantity of acrylamide (µg/Kg) in seven potato crisps ($p< 0.05$)

T-test was used to compare the mean acrylamide contents of potato crisps produced at home and abroad.

According to the assessments made, the acrylamide contents of potato crisp samples produced by different factories varies from each other as reported previously. T7 sample contained the least amount (220 µg/kg) while T1 sample had the highest (1456.7 µg/kg) concentration. According to the new Iranian Standard, No. 3764, the concentration of acrylamide in potato crisp must not exceed 1200 µg/kg. The results showed that T1 sample (1456.67 µg/kg) exceeded the standard limit (Iran Standard Method, 2011). In 2009, Ministry of Health of Canada warned the harmful effect of fried foodstuffs, particularly potato crisp (Zyzak *et al*., 2003). Foods with high acrylamide content supply 38% of daily energy, 47% of iron and 42% of folic acid required by the body (Low *et al*., 2006; Claus *et al*., 2008). The rate of acrylamide formation in potato crisps has been reported in different countries. In Poland, the formation of this compound in potato crisp is between 372-3647 µg/kg (Mojska *et al*., 2006) while in Austria is 1500 µg/kg maximum (Arisseto *et al*., 2007) and in Japan it is reported over 1000 µg/kg for all potato crisps and potato-based snacks (Yoshida *et al*., 2005). Considering the results obtained from the present research, the rate of acrylamide formation in potato crisps sold in Iranian market in 2010 was less than some countries. These differences might indicate different processing conditions including frying temperature, frying period, percentage of sugar present in potato. The rate of acrylamide formation in foodstuffs produced in different sizes but the same processing conditions might clearly be different (Tareke *et al*., 2002). The formation of acrylamide during the course of Millard reaction might be affected by many factors including food matrix, a_w, and the pH (Weiss, 2002). The effect of this toxic compound in human and some laboratory animals have been known for sometimes but care must be taken to minimize its formation and consumption by the consumers.

Conclusion

According to the present research, there is a meaningful difference in the rate of acrylamide formation in potato crisps produced in Iran as compared to the crisps produced in foreign countries. Considering the international standard for the rate of acrylamide formation in potato crisp, only one sample (T1) containing 1456.67 µg/kg was excluded according to the Iranian National Standard. This study must be repeated often with crisps of different shapes to understand more about the machanisms involved and use the results to inform the consumers about the harmful effect of different products.

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