

TECHNOLOGICAL AND MEDICAL ASPECTS OF INSTANT NOODLE SAFETY

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Abstract. The purpose of the work was to study some safety indicators of the fat component of instant noodles, the most popular brands in the Russian Federation, and to predict their potential effects on the human body. The subject of the study was the physicochemical changes of the extracted fat component from fast food products. The most popular instant products - instant noodles of 3 popular brands were selected as the objects of research. According to the results of studies, it was noted that the mass fraction of compounds insoluble in petroleum ether is more than 1% - 1.2 and 1.1, respectively, and exceeds the recommended norms for deep fat. The content of epoxides exceeds the recommended allowable level of 17-24 mmol / kg by almost 2-2.2 times. The increased content of fat oxidation products is a potential risk factor that provokes diseases of the gastrointestinal tract, cardiovascular and immune systems, as well as changes in the blood formula. The data obtained indicate the need for a critical assessment of production technology, as well as the advisability of introducing regulatory standards regarding the safety control of the fat component of fast food products in order to reduce the effects of toxic products of fat oxidation on the human body and, as a consequence, reduce the prevalence of civilization diseases.

1 Introduction

The diets of modern human nutrition are an integral risk factor for human health, as they are characterized by nutritional imbalances: high calorie content, excess fats with a deficiency of polyunsaturated fatty acids, lack of complete proteins; pronounced superiority in the consumption of quickly digestible sugars; low content of fiber, vitamins, and macro- and micronutrients [1,2,3].

The main causes of food imbalances are industrialization, urbanization and globalization of the food and services market, which have changed not only food production, but also the stereotype of food choices in favour of industrially produced foods and fast food [4].

Industrial production and consumption of fast food products is growing steadily in all countries of the world, as evidenced by statistics from household food expenditure surveys in different countries. The main advantage of such products for the consumer is the ease of storage and preparation, for the manufacturer - the unification and duplication of technology, while allowing one to have a wide range and taste and aromatic diversity, taking into account ethnic preferences.

However, the use of fast foods in the diet causes a reaction of prolonged adaptation of the body to a new composition of nutrition, a stress, and, a health disorder [5, 6]. Experts note a steady trend towards the spread of chronic noncommunicable diseases not only in

developed countries, but also among the population of developing ones when their diet changes. In this regard, according to existing forecasts, by 2025, the number of people with diabetes in developing countries will grow by more than 2.5 times, reaching 228 million people worldwide. At the beginning of the XXI century, the number of patients with cardiovascular pathologies in India and China was more than in all developed countries.

One of the most popular foods in many countries is instant noodles. In 2017, global consumption of instant noodles reached 100 billion servings, roughly equivalent to 13 servings per year for every person in the world. The record holders for noodle consumption are the Republic of Korea, Vietnam, Indonesia, Japan, Thailand and other Asian countries, which is explained by their food culture. Rather high consumption is marked in New Zealand and Australia, high in the USA and some European countries [7].

A key difference between instant noodle technology and traditional noodle production is dehydration in hot oil (at temperatures above 150 °C). Due to such processing, noodles absorb hot water in a minute and reach culinary readiness. During short frying, the semi-finished noodle absorbs about 20% of fat, which becomes a food ingredient and one of the safety factors of this product.

For frying noodles, deep fat is used, which is exposed to high temperatures for a long time. Under such

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conditions, profound changes in fat occur, accompanied by the accumulation of toxic fat oxidation products that affect the human body. The migration of thermally modified fats into a product and their thermal modification are studied by scientists, however, taking into account new studies [8], safety indicators are not fully identified and regulated at the legislative level.

The processes of fat absorption, lipid metabolism, and the adsorption of polar compounds on food surfaces during frying were investigated by Marmesat et al.; Pérez-Camino et al.; Pozo Díez et al.; Sebedio et al. [9,10,11].

Studies have shown that fat absorption depends on the type of food. Besides, the same levels of polar compounds, polymers and minor components were found in the fat component extracted from fried foods and the deep fat.

Studies of deep fat and extracted lipid products that were fried in it showed an identical fatty acid content, indicating a very high degree of lipid metabolism. Scientists Pérez-Camino et al. [10] were carried out studies showing the fatty acid content of the initial lipids of foods and deep fat, which were very different, and those that remain in the fried product and are transferred to deep fat. Regardless of the fatty acid composition of the oil and the type of product pre-fried, frozen and deep-fried, more than 90% of the fat from lipids is transferred to the product, while more than 85% of the lipids from the product is deep-fried.

With this background there is a need to clarify the processes of chemical interaction between deep fat and deep-fried products in the real conditions of the production process to identify potential hazards when consuming this category of food.

Prediction of the effect of long-term consumption of fast food products on health can come from an analysis of the processes of transformation of food substances in the technological flow of production.

The aim of this work was to study some safety indicators of the fat component of instant noodles, the most popular brands in the Russian Federation, and to predict their potential effects on the human body.

2 Methods

The subject of the study was the physicochemical changes in the fat component of fast food products. The most popular fast food products among consumers in the Russian Federation - instant noodles of 3 popular brands were selected as the objects of the study.

Shelf life of instant noodles is 12 months. The opening of sealed packages purchased through retail chains was carried out in the initial period of validity - in the third month of storage.

Fat for analysis was isolated from the product by the extraction-weight method [12].

In the extracted fat, the fatty acid composition was determined by gas-liquid chromatography of methyl esters of fatty acids [13]. Fatty acid methyl esters were prepared according to [14] and the averaged fatty acid composition of the studied products was analyzed.

The normative documentation of the Customs Union (TR TS -Technical Regulations of the Customs Union - 0211/2011, TR TS 033/2013) regulates only the determination of the peroxide number, which characterizes the accumulation of primary products of fat oxidation. The peroxide number of the fat component of the product was determined by the iodometric method [15].

To assess the degree of hydrolysis and oxidation of the fat component of noodles, the acid number of the released fat was determined by the titrimetric method [16], as well as the content of secondary oxidation products insoluble in petroleum ether (SNPE) according to [17], and the content of epoxides by reaction with concentrated phosphoric acid [18]. All studies were carried out immediately after opening the packages with noodles.

Determination of acid number is important for determining the degree of hydrolysis of fat. This indicator is of particular importance, since the process of noodle dehydration during frying can be accompanied by intensive hydrolysis of fats, which provokes the accumulation of di- and monoglycerides, which, according to modern data, can be precursors of the dangerous toxicant 3-chloropropanediol (3-MCPD) [19].

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3 Results

In noodle samples, a comparative assessment of the mass fraction of fat extracted from the product and labeled on the package was carried out (Figure 1).

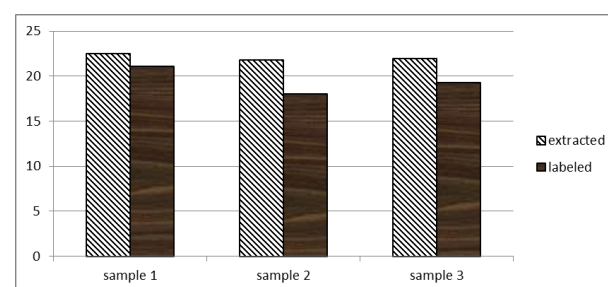


Fig. 1. Mass fraction of fat in instant noodles, %.

As the analysis of the results obtained during the experiment showed, the content of the mass fraction of extracted fat in all samples exceeds the labeled on the package. A higher proportion of fat in foods is likely due to increased absorption of fat by the product during dehydration with hot oil. As a number of studies [21,22] show, the increase in oil absorption depends on the state (quality) of fat. The influence of fat quality is explained by oxidative degradation of oils and the formation of compounds that increase the polarity of the frying medium. During the frying process, fat accumulates polar compounds, the level of surfactants increases, oil absorption proceeds more intensively. Although there

are a number of other theories [23] regarding oil absorption, nevertheless, it can be noted that the rate of absorption of fat can change under the influence of numerous factors affecting the technological process of deep-frying. In this aspect, there is no possibility of predicting the real nutritional value of the diet including these products.

Table 1. The fatty acid composition of fats in instant noodles.

Sample	The fatty acid composition, %						
	C12:0	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3
1	0.4	1.2	44.6	4.3	38.6	10.7	0.4
2	0.2	1.0	43.9	4.4	39.7	10.8	—
3	0.2	1.1	44.7	4.1	38.9	10.6	0.4

In the study of the fatty acid composition of the analyzed products, it was found out that palm oil is prevailing in the fat component. Palm oil differs from other vegetable fats in its high content of saturated fatty acids. Excessive intake of saturated fats is one of the most important risk factors for obesity, diabetes, cardiovascular and other diseases. Norms of consumption for saturated fats are not established by regulatory documents, however, according to WHO recommendations, their energy value in the diet in the norm of the total amount of fats should not exceed 10%. On the other hand, palm oil and its fractions can be considered as a partial alternative to hydrogenated fats in the production of certain types of oil and fat products, in particular, deep fats. Table 2 presents the quality and safety indicators of the fat component of instant noodle samples.

Table 2. Results of research of the quality and safety indicators of the fat component of instant noodle.

Sample	Acid number, mg KOH / g	Peroxide value, Mmol/2O / kg	Mass fraction of oxidation products insoluble in petroleum ether, %	The content of epoxides, mmol / kg
1	0.3	6.0	1.2	52.1
2	0.5	5.1	0.8	52.9
3	0.3	5.5	1.1	52.3

Analyzing the data of Table 2, we can conclude that the safety indicator - peroxide number is within the normal range for all samples, standardized according to TR TS 021/2011 "On Food Safety".

The limit value of the acid number for fats is determined by the regulatory documentation of the Customs Union. According to TR TS 024/2011 "On fat and oil products" the acid value for refined oils and their fractions, mixtures of refined oils, is normalized to not more than 0.6 mg KOH / g. According to the results of the study, the acid number does not exceed this indicator, only in sample 2: the content of free fatty acids in the fat component is close to the threshold value and is 0.5 mg KOH / g.

The mass fraction of compounds insoluble in petroleum ether for spent deep fat fats is regulated according to SP 2.3.6.1079-01 - not more than 1%. This indicator has not yet been reflected in ensuring the safety of the fat component of other food products, although there are a number of works that indicate the need for its regulation [24, 25]. In samples 1 and 2, the mass fraction of compounds insoluble in petroleum ether is more than 1% - 1.2 and 1.1, respectively. The content of epoxides exceeds the recommended allowable level of 17-24 mmol / kg by almost 2-2.2 times.

4 Discussion

Based on the results of the study, in the production of instant noodles, manufacturers comply with the safety parameters of deep fat regulated by TR TS 021/2011 and 024/2011. The need to comply with the requirements of SP 2.3.6.1079-01 for the control of toxic compounds insoluble in petroleum ether is not taken into account. In the normative documentation and in the real technological process there is no control of non-standardized, but important oxidation products epoxides that affect human health. The formation of highly polar compounds insoluble in petroleum ether and epoxides was discovered by us in the study of deep-fried dough products, as well as during the storage of confectionery products with a high fat content. In a biological experiment on animals in our previous studies, it was shown that fats containing more than 1% of compounds insoluble in petroleum ether, have a negative effect on the organs of the gastrointestinal tract with systematic consumption, sharply reduce the level of red blood cells and leukocytes in the blood, and cause the accumulation of cholesterol and bilirubin [27]. Our studies correlate with the studies of scientists from different countries. For example, data on pathological changes in the body when consuming oxidized and thermally oxidized fats are known [28]. Fat decomposition products are toxic, they have a carcinogenic effect, the ability to cause diseases of the gastrointestinal tract and liver, growth retardation, irritation of the skin and mucous membranes, as well as the development of malignant tumors [29, 30, 31].

5 Conclusion

After study of the safety of the fat component of instant noodles, it was found out that the safety parameters of the fat component regulated by TR TS 021/2011, TR TS 024/2011 do not fully reflect the safety requirements for the fat component of fast foods blanched with hot oil, since there are no standards of the most important indicators of fat safety - the content of secondary oxidation products - compounds insoluble in petroleum ether and epoxides. In our opinion, it is necessary to study safety indicators of the fat component of fast food products in terms of their effect on the body when they are included in diets.

The data obtained indicate the need for a critical assessment of production technology, as well as for

advisability of introducing regulatory standards regarding the safety control of the fat component of fast food products in order to reduce the effects of toxic products of fat oxidation on the human body and, as a consequence, reduce the prevalence of civilization diseases.

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