# Studying the Safety of Instant Noodles Sold in Egyptian Hypermarkets

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## Abstract

Instant noodles are one of the staple foods that are popular all around the world. Recently, global demand for noodles has been increasing gradually. This study aims to determine certain safety parameters for spices and liquid seasoning oils that are used in instant noodles available in Egyptian hypermarkets. A total of 90 packets were purchased including four of the main available brands of instant noodles. These samples were categorized as follows: Brand I produced in 7 flavors, Brand II produced in 3 flavors, Brand III produced in 3 flavors and Brand IV produced in 2 flavors. All purchased samples had nearly the same expiry date. The following parameters were measured: aflatoxin content (B1, B2, G1 and G2), heavy metals (Cd, Pb, Hg, As) and oxidation potential. Spices in all brands were free from mercury except for the seafood and shrimp flavors, which had Hg contents of 0.02 and 0.32 ppm, respectively. Cadmium contents of 0.42 and 0.36 ppm were found in shrimp flavor in brands IV and II, respectively, which were higher than the Egyptian standards (0.2 µg/g). Processed tomato flavor had the highest contamination of AFB1 (5.1 ppb). Brand IV Creamy Shrimp flavor and Brand I Special chicken flavor had the highest iodine values of $2.86 \pm 0.04$ and $1.45 \pm 0.02$, respectively. Thus consumption of instant noodles is still a risky choice because some flavors contain aflatoxins and heavy metals exceeding the Egyptian standard limits. In addition, extensive studies on experimental animals are needed to evaluate the safety of noodles and health hazards from the consumption of spices and liquid seasonings.

**Key words:** Aflatoxins, heavy metals, noodles, rancidity parameters, safety
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## 1. Introduction

Noodles are widely consumed throughout the world and their global consumption is second only to bread; it is a fast growing sector of the pasta industry. This is because instant noodles are convenient, easy to cook, low cost and have relatively long shelf-lives [1]. The cooking time of noodles is very much lower than that for other types of food products, and fast life styles in the dynamic societies of today have led to the use of this product as an ideal option for people's crucial time management process [2]. During the twentieth century, the consumption of instant noodles grew steadily, and it is still growing. Based on data from the World Instant Noodles Association in 2016, over the span of the five years from 2011-2015,

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people around the world consumed 507.570 million servings of instant noodles or 101.514 million servings per year. According to the global demand for instant noodles estimated by World Instant Noodles Association (WINA) in year 2017, Egypt consumption of instant noodles was found to be 150 million servings in year 2012, 170 million servings in 2013, 190 million servings in 2014, 200 million servings in 2015, and 210 million servings in 2016 [3].

Continuous consumption of these noodles may lead to heavy metal toxicity, which can result in impaired neuronal and renal functions such as liver cirrhosis, tubular nephritis dysfunction and reduction in neuropsychological function [4]. Although some of the heavy metals are within the permissible limits, instant noodles consumption could still be unsafe because of the cumulative potential of these contaminants. Moreover, consumers of some brands may be predisposed to carcinogenesis due to the high polycyclic aromatic hydrocarbons (PAH) content in those brands [5]. This study was conducted to determine the chemical composition of instant noodles available in Egyptian hyper markets. Included in the study are analysis of the aflatoxin content of instant noodles' spices and the heavy metals content of spices and liquid seasoning, and measurement of the oxidation potential of liquid seasoning materials.

## 2. Materials and Methods

#### 2.1 Data collection methods and tools

A pilot study was done over the period of June-July 2017 to screen for the brand availability in the main hypermarkets in Alexandria Governorate, Egypt. The survey clarified the presence of 4 different brands of instant noodles available in markets including local and international brands. There were four different brands of instant noodles available, namely Brand I, Brand II, Brand III and Brand IV, and each brand had various flavors on sale. Six packets of each flavor from each brand were purchased from the main hypermarkets in Alexandria; and two packets of each flavor from each of the following branches; Carrefour hypermarket in Muharum Beek, Metero Hypermarket in Smouha and Fathallah hypermarket in Elmontazah. These branches were considered to be the main distributors to small markets. The collected 6 packets of the same flavor from same brand were homogenized and mixed well in a blender to obtain random and representative samples. The packets contained either spices or seasoning oil or both according to the manufacturing company. All the purchased samples had nearly the same expiry date. A total of 90 packets were purchased from the four main available brands of instant noodles. These samples were categorized as follows: Brand 1 (produced in 7 flavors), Brand 2 (produced in 3 flavors), Brand 3 (produced in 3 flavors) and Brand 4 (produced in 2 flavors).

### 2.2 Quantification of aflatoxins (B1, B2, G1 and G2)

The determination of the aflatoxins levels in spices packets and dried vegetables packets present in certain flavors was done using HPLC technique [6-8]. The HPLC conditions (Thermo-scientific Ultimate 3000) [8, 9] were as follows:

Mobile phase: Water 54, Methanol 29, Acetonitrile 17

Mobile phase flow: 0.5 ml/m

Column: $C_{18}$100Rp-18.25 cm

Fluorescence detector: Emissions 460, Excitation 360

### 2.3 Estimation of heavy metal content

The heavy metals in liquid seasoning, spices and dried vegetables present in some flavors were identified using inductively coupled plasma mass spectrometry (ICP-MS). ICP-MS measurements were performed using a VG Plasma Qua Ex-Cell (Thermo, Courtaboeuf, France). The sample solutions were pumped by a peristaltic pump from tubes arranged on a CETAC, Varian 720-ES Inductively Coupled Plasma [10]. ICP-MS operating conditions were as follows:

Perkin Elmer Elan DRC II: Spray chamber Cyclonic Nebulizer, Meinhard RF power (W) 1100, Ar nebulizer gas flow (L min1) 0.6-0.9 (optimized daily),

Measures: Scan mode Peak hopping, Resolution (amu) 0.7, Replicate time (s) 1, Dwell time (s) 50 Sweeps/reading 20, Integration time (ms) 1000 and Replicates.

### 2.4 Sample preparation

Noodles were ground using a grinder. One hundred mg of each sample was treated with 10 ml of $HNO_3$ (65%), and heated up to 130°C till dryness. After cooling, 5 ml of $H_2O_2$ (40%) was added to the sample and then it was heated at 130°C till dryness. After cooling, the sample was then diluted with 20 ml distilled water [11-14] and filtered twice through Whatman filter paper grade II into a glass bottle [15].

Five ml of each sample of seasoning liquid oil was added to 5 ml of $HNO_3$ in a flask, which was then placed on hot plate at 100°C until almost complete volume reduction took place (almost to dryness). The sample was then cooled and 5 ml of HCL was added. It was then heated at 100°C till dryness. Each sample was cooled and diluted with distilled water (20 ml) and filtered twice through Whatman filter paper grade II into a glass bottle [15].

### 2.5 Rancidity parameters

Purchased packets of oil were taken from the samples to check rancidity which was expressed as the acid value and the iodine value [16-18].

Calculation for acid value:

$$\text{Acid value (mg KOH/g)} = \frac{\text{titration (ml)} \times 5.61}{\text{weight of sample used (g)}}$$

Calculation for Iodine value:

$$\text{Iodine value} = \frac{(b-a) \times 1.269}{\text{weight of sample (g)}}$$

Where a= titration of sample (ml) and b= titration reading of blank (ml).

## 3. Results and Discussion

There is not much recent information available on safety of instant noodles sold in Egyptian markets. Analysis of heavy metal content in spices (Table 1) showed there was an elevated Cd concentration in Brand I with shrimp flavor (0.36µg/g), which is higher than the Egyptian Standard (ES) 7136/2010 for Cd, which is 0.2 µg/g [19]. Abou-Arab and Abou Donia [20] studied the contamination of Egyptian spices and medicinal plants with heavy metals, and found that the maximum level of Cd was 2.44 µg/g, which is in contrast to the results of the present study. In addition, Krejpcio *et al*. [21] found an elevated content of Cd in basil (0.47 mg/kg) and savory (0.40 mg/kg). However, Sharma *et al*. [22] revealed that the concentration of cadmium (Cd) in spices ranged from 0.194-3.17 ppm, which was higher than the maximum level in this study, and may have been due to the use of different types of spices; spices that may have come from different agro-ecological regions and which may have been stored differently.

Sattar *et al*. [23] found that mixed spices generally exhibited high values for trace metals, especially cadmium (0.65-1.34 µg/g), values which were higher than the maximum concentration found in the present study (Table 1). However, the highest content of trace metals found in the present study was for lead at 0.42 ppm, in Brand (IV) with shrimp flavor, which was higher than Egyptian Standard (ES) 7136/2010 (0.3 ppm). According to the Codex

**Table 1.** Heavy metals content (µg/g, ppm) in spices present in different studied brands of instant noodles

| Spices | Unit | N | Cd | (ES) No 7136/2010 | Pb | (ES) No 7136/2010 | Hg | EC) No 1881/2006 | As | (ES) No 7136/2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Brand I | | | | | | | | | | |
| Chicken flavor | | | 0.12 ± 0.02 | | 0.19 ± 0.03 | | 0.0 ± 0.0 | | 0.02 ± 0.02 | |
| Paprika flavor | | | 0.23 ± 0.03 | | 0.13 ± 0.02 | | 0.0 ± 0.0 | | 0.01 ± 0.01 | |
| Chicken curry flavor | | | 0.14 ± 0.04 | | 0.09 ± 0.01 | | 0.0 ± 0.0 | | 0.01 ± 0.01 | |
| Special chicken flavor | | 6 | 0.12 ± 0.02 | | 0.14 ± 0.01 | | 0.0 ± 0.0 | Not mentioned in (ES) No 7136/2010 | 0.02 ± 0.02 | |
| Shrimp flavor | | | 0.36* ± 0.02 | 0.20 | 0.26 ± 0.01 | | 0.05 ± 0.01 | | 0.03 ± 0.02 | Not mentioned in (ES) No 7136/2010 |
| Beef flavor | | | 0.24* ± 0.03 | | 0.18 ± 0.01 | 0.30 | 0.0 ± 0.0 | | 0.02 ± 0.02 | |
| Vegetable flavor | | | 0.11 ± 0.02 | | 0.14 ± 0.04 | | 0.0 ± 0.0 | | 0.09 ± 0.02 | |
| Super me vegetable flavor | | | 0.16 ± 0.02 | | 0.11 ± 0.04 | | 0.0 ± 0.0 | | 0.0 ± 0.0 | |
| Brand II | | | | | | | | | | |
| Tomato flavor | µg/g | | 0.18 ± 0.04 | | 0.24 ± 0.03 | 0.30 | 0.0 ± 0.0 | Not mentioned in (EC) No 1881/2 | 0.0 ± 0.0 | Not mentioned in (ES) No 7136/2010 |
| Processed tomato flavor | | 6 | 0.17 ± 0.01 | | 0.14 ± 0.03 | | 0.0 ± 0.0 | | 0.0 ± 0.0 | |
| Cheese flavor | | | 0.14 ± 0.03 | 0.20 | 0.10 ± 0.03 | | 0.0 ± 0.0 | | 0.01 ± 0.01 | |
| Paprika flavor | | | 0.15 ± 0.02 | | 0.09 ± 0.01 | | 0.0 ± 0.0 | | 0.0 ± 0.0 | |
| Brand III | | | | | | | | | | |
| Beef flavor | | | 0.12 ± 0.02 | | 0.14 ± 0.04 | | 0.0 ± 0.0 | Not mentioned in (ES) No 7136/2010 | 0.0 ± 0.0 | Not mentioned in (ES) No 7136/2010 |
| Paprika flavor | | 6 | 0.11 ± 0.02 | 0.20 | 0.18 ± 0.04 | 0.30 | 0.0 ± 0.0 | | 0.0 ± 0.0 | |
| Chicken flavor | | | 0.13 ± 0.02 | | 0.08 ± 0.03 | | 0.0 ± 0.0 | | 0.0 ± 0.0 | |
| Vegetable flavor | | | 0.19 ± 0.04 | | 0.14 ± 0.03 | | 0.0 ± 0.0 | | 0.0 ± 0.0 | |
| Brand IV | | | | | | | | | | |
| Sea food flavor | | 6 | 0.33* ± 0.03 | 0.20 | 0.21 ± 0.04 | 0.30 | 0.02 ± 0.02 | 0.50 | 0.04 ± 0.03 | Not mentioned in (ES) No 7136/2010 |
| Shrimp flavor | | | 0.31* ± 0.02 | | 0.42* ± 0.04 | | 0.02 ± 0.02 | | 0.05 ± 0.04 | |

Detection Limit: 0.01µg/g
Accuracy: 98.6%
Precision: 0.97.2%
Bias: -0.04 µg/g

standard 193-1995 toxicological guidance values, it was previously established that provisional tolerable weekly intake (PTWI) of 25 µg/kg.bw was associated with a decrease of at least 3 intelligence quotient (IQ) points in children and an increase in systolic blood pressure of approximately 3 mm Hg in adults [24].

Sattar *et al*. [23] also found that mixed spices generally exhibited high values for trace metals, especially lead (6.6-9.2 µg/g), which is in contrast to the results of the present study. Sharma *et al*. [22] stated that lead was 1.52-2.92 ppm, which is very much higher than the result of the present study. Krejpcio *et al.* [21] found elevated amounts of lead in cinnamon (6.24 mg/kg), basil (2.25 mg/kg) and savory (1.29 mg/kg). Abou-Arab and Abou Donia [20] stated that the maximum level of lead in Egyptian spices and medicinal plants in studied samples was 14.4 µg/g, which is much higher than results of the present study. All tested brands were free from mercury (Hg,) except for Brand I with shrimp flavor (0.05 ppm) and Brand (IV) with seafood and shrimp, which showed a content of 0.02 ppm, which might have been due to the presence of traces of powdered fish in the spices. Interestingly, the concentration of Hg is not mentioned in Egyptian Standards (ES) 7136/2010. Sharma *et al.* [22] revealed that mercury (Hg) concentration ranged from 0.1-0.3 ppm, which is more than double the results of this study. On the other hand, Nkansah and Amoako [25] examined the concentrations of Hg in fifteen spices available at local markets in the Kumasi Metropolis and stated that the maximum level for Hg was 0.025 mg/kg, which is nearly the same as the results of the present study.

Arsenic (As) was found at high level in Brand I with vegetable flavor (0.09 ppm), which may be attributed to the presence in the spices of traces of dried vegetables that had been irrigated with contaminated water and industrial wastes. Meanwhile, arsenic is mentioned in Egyptian Standards (ES) 7136/2010 [19]. According to Codex standard 193-1995 and toxicological guidance values, the intake of arsenic should not exceed 3.0 µg/kg bw/day (2-7 µg/kg bw/day based on the range of estimated total dietary exposure) [24].

Soliman [26] stated that the concentration of arsenic in spices and herbs available in the Egyptian market ranged from 0.02 (in paprika) to 0.11mg/kg in cloves, results which are similar to the results of this study. Research in Mumbai revealed that the concentration of arsenic (As) in fennel seed samples was 0.92 ppm [22], which was much higher than we found. Spices in Brand (I) had the highest content of Cd in shrimp flavor and Asenic in the vegetable flavor, while Brand (IV) had the highest content of Hg in shrimp flavor. The latter may be attributable to the shrimp having been raised in sea water or irrigation water that had been contaminated by heavy metals from sewage or industrial wastes.

The comparison of heavy metals content in liquid seasonings (oil) present in some of the brands of instant noodles (Table 2) revealed that Brand (IV) had the highest content of Cd (0.29 ppm) in the shrimp flavor variant, followed by seafood flavor (0.27ppm). However, Cd is not mentioned in Egyptian Standards (ES) 7136/2010. Cadmium is known to be toxic if its level exceeds the Codex toxicological guidance values, and the Cd provisional tolerable monthly intake (PTMI) is 25 µg/kg bw. The presence of metals in vegetable oils is either due to plant metabolism or contamination during the agronomic techniques of production and collection of seeds during oil extraction and treatment processes. It may also be due to materials used for packaging and storage [27].

The presence of metals in oil can facilitate oxidative degradation of the oil and decrease shelf life. It may also have adverse effects on the flavor, color and odor [28]. The concentrations of heavy metals in oil-producing plants depend on many factors, such as plant species, soil types, anthropogenic pressure, fertilization and hydrological conditions (irrigation) [29]. Szyczewski *et al*. [30] concluded that concentration of Cd in different types of oils ranges from 0.03-0.65 ppm, numbers which are in line with the present results (Table 2). Mohammed *et al.* [31] found concentrations of heavy metals in sesame oil (0.11 mg/kg) that were in line with our results. Karthik and Vijayarekha [32] found the level of mercury in sunflower oil ranged from 71.44-87.94 ppm, which is contrary to the results of the present study that indicates low Hg contamination. Differences could be due to different types of spices being added to liquid seasoning oil. Aflatoxin B1 is responsible for both toxicity and carcinogenicity. It was classified as a group I carcinogen by the International Agency for

**Table 2.** Heavy metals content (µg/g, ppm) in liquid seasoning oils present in different studied brands of instant noodles

| Oil | unit | N | Cd | (ES) No 7136/2010 | Pb | (ES) No 7136/2010 | Hg | (ES) No 7136/2010 | As | (ES) No 7136/2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| Brand I | | | | | | | | | | |
| Chicken curry | µg/g | 3 | 0.13±0.01 | Not mentioned in (ES) No 7136/2010 | 0.12*±0.02 | 0.10 | ND | Not mentioned in (ES) No 7136/2010 | 0.06±0.01 | Not mentioned in (ES) No 7136/2010 0.1 mg/kg according to Codex |
| Special chicken | | | 0.14±0.02 | | 0.08±0.01 | | ND | | 0.02±0.01 | |
| Vegetable | | | 0.12±0.03 | | 0.21*±0.04 | | ND | | 0.01±0.01 | |
| Brand IV | | | | | | | | | | |
| Sea food | | | 0.27±0.02 | | 0.28*±0.03 | | 0.03±0.01 | 0.50 | 0.04±0.02 | |
| Shrimp | | | 0.29±0.02 | | 0.24*±0.01 | | 0.32±0.03 | | 0.03±0.02 | |

ND: Not detected
Detection Limit: 0.01µ/g
Accuracy: 98.6%
Precision: 0.97.2%
Bias: -0.04 µ/g

Research on Cancer (IARC). The disease caused by the consumption of aflatoxins is known as aflatoxicosis, and it can lead to cancer, immune suppression and other slow pathological conditions. Acute aflatoxicosis leads to death. The liver is the main target organ [33].

The comparison of the aflatoxin B1 content of spices and paprika in different brands of instant noodles (Tables 3) revealed that processed tomato flavor in Brand (II) had the highest content of AFB1 (5.1 µg/kg), and was followed by Brand (I) vegetable flavor (4.6 µg/kg). This may be attributable to the high level of moisture in tomato and vegetables flavors during production of spices, which enhances the growth of fungus producing aflatoxins [19]. The level of AFB1 in paprika in Brand I was high (0.6 µg/kg), but less than the Egyptian Standard (ES) 7136/2010 (5 µg/kg), and thus it lies within the safe limit.

In Algeria, Azzoune *et al*. [34] reported that 23 of 36 samples of spices contained AFB1 ranging from 0.2 to 26.50 μg/kg, while Sugita-Konishi *et al*. [35] found that only one sample of 6 red pepper samples was contaminated with aflatoxins, but it was at the level of 16.7 μg/kg, which was very much higher than our results. Martins *et al*. [36] studied twelve different pre-packaged spices marketed in Portugal and found 43% of the samples including paprika and chili powder were contaminated with aflatoxin B1 in the ranges of 1-18.2 μg/kg and 1.9-2.5μg/kg, respectively, which is in line with the results of the present study .

El-Kady *et al*. [37] studied a total of 120 different samples of 24 kinds of spices and reported the presence of AFB1 (8± 35 mg/kg). Another study by Selim *et al*. [38] found the prevalence of AFB1 in 10 samples of Egyptian spices was 40%, with a mean value of 25 mg/kg, which was very much higher than results of this study. This may have been due to El-Kady *et al*. [37] studying different types of spices to those analyzed in the present research, and /or due to differences in the storage conditions [39].

The highest aflatoxins content reported in this work was in Brand (II) processed tomato flavor (10.74 µg /kg) (Table 4). A UK study found that nine samples from eighteen different spices were contaminated with total aflatoxins above the recommended level for aflatoxins in the UK (10 µg/ kg), and the highest level was 48 µg /kg in chili powder, which was much higher than results of the present study [40]. Contamination of spices starts mainly in the field due to the humidity and high temperature in which plants are grown, and it can continue during handling and processing because of drying on bare ground. Contamination can be prevented by growing and harvesting spices according to good agricultural practices in areas free from harmful chemicals. Appropriate quality control measures in accordance with the principals of good handling practice, good manufacturing practice, hazard analysis and critical control points should be implemented at all stages after harvesting.

Aflatoxin B1 in dried vegetables in Brand IV seafood flavor, which was the only brand containing dried vegetables, was 0.17 µg /kg (Table 5). A study on aflatoxins in dried vegetables in Benin, Mali and Togo showed dried vegetables were contaminated with fungi, which led to mycotoxin development and the presence of aflatoxin B1 and aflatoxin B2 in dried okra to the extent of 5.4 µg /kg and 0.6 µg/kg, respectively. Total aflatoxins content was 6 µg /kg in okra and 3.2 µg /kg in hot chili [41], which is in line with results for chili powder in the present study. The assessment of aflatoxins in dried vegetables from selected markets in Kaduna Metropolis revealed that the highest aflatoxin content was in dried baobab at 31.6μg/kg, while 27.00 μg/kg were found in dried okra and 26.40 μg/kg in red chili pepper. Tomatoes had the lowest aflatoxin content (6.50 μg /kg) [42]. The results were much higher than our results. This could be due to different items to ours being analyzed.

High iodine values indicate high degrees of unsaturation and high susceptibility to rancidity. Brand IV shrimp flavor had the highest iodine value (2.86 µg/g), while Brand I vegetable flavor (0.96 µg/g) contained the least unsaturation and susceptibility to rancidity (lipid oxidation) (Table 6) and thus offered a longer shelf life. High unsaturated fats under conditions of high temperature and humidity are liable to bacterial attack. The bacteria can secret lipase enzymes which break double bonds giving free fatty acids responsible for off flavor, bad taste and rancidity [43]. The comparison of acid values for liquid seasoning present in different studied brands of instant noodles clarified that Brand I vegetable flavor had the highest acid value (5.8 mg/g) (Table 7), indicating a high degree of rancidity with liberation of free fatty acid. The lowest amount was found in Brand IV shrimp flavor (1.96 mg/g). However, there is not enough information about rancidity parameters in liquid seasoning oils in noodles from previous studies.

**Table 3.** Aflatoxin B1 content (μg/kg) in spices and paprika in different brands of instant noodles

| Spices | Aflatoxin B1 (μg/kg) | (ES) No 7136/2010 (μg/Kg) |
|---|---|---|
| Brand I (Indomie) | | |
| Chicken flavor | 0.9 | |
| Paprika | 0.6 | |
| Chicken curry flavor | 0.15 | |
| Special chicken flavor | 0.11 | |
| Shrimp flavor | 0.18 | |
| Beef flavor | 0.12 | |
| Vegetable flavor | 3.4 | |
| Super me vegetable flavor | 4.6 | |
| Brand II (El Maleka) | | |
| Tomato flavor | 2.8 | 5 |
| Processed tomato flavor | 5.1* | |
| Cheese flavor | 3.2 | |
| Paprika flavor | 0.19 | |
| Brand III (Kelloges) | | |
| Beef flavor | 0.6 | |
| Paprika | 0.15 | |
| Chicken flavor | 0.18 | |
| Vegetable flavor | 2.2 | |
| Brand IV (FF) | | |
| seafood flavor | 0.14 | |
| Creamy shrimp flavor | 0.17 | |

Detection Limit: 0.5μg/kg
Accuracy: 99.1%
Precision: 0.98.4%
Bias: -0.2 μg/kg

**Table 4.** Aflatoxins content (µg/kg) in spices and paprika of different brands of instant noodles

| Spices | Aflatoxins (µg/kg) | | | | | |
|---|---|---|---|---|---|---|
| | **AFB1** | **AFB2** | **AFG1** | **AFG2** | **AFB1+ AFB2+ AFG1+ AFG2** | **(ES) No 7136/2010** |
| Brand I (Indomie) | | | | | | |
| Chicken flavor | 0.9 | 0.5 | 0.42 | 0.38 | 2.2 | |
| Paprika | 0.6 | 0.33 | 0.5 | 0.28 | 1.71 | |
| Chicken curry flavor | 0.15 | 0.16 | 0.12 | 0.19 | 0.62 | |
| Special chicken flavor | 0.11 | 0.18 | 0.23 | 0.13 | 0.65 | |
| Shrimp flavor | 0.18 | 0.7 | 0.5 | 0.28 | 1.66 | |
| Beef flavor | 0.12 | 0.09 | 0.17 | 0.15 | 0.53 | |
| Vegetable flavor | 3.4 | 1.6 | 1.1 | 0.7 | 6.8 | |
| Super me vegetable flavor | 4.6 | 0.15 | 0.7 | 0.41 | 5.86 | |
| Brand II (El Maleka) | | | | | | |
| Tomato flavor | 2.8 | 1.7 | 0.15 | 0.19 | 4.84 | 10 |
| Processed tomato flavor | 5.1 | 4.1 | 1.4 | 0.14 | 10.74* | |
| Cheese flavor | 3.2 | 1.2 | 1.8 | 0.14 | 6.34 | |
| Paprika flavor | 0.19 | 0.15 | 0.11 | 0.24 | 0.69 | |
| Brand III (Kelloges) | | | | | | |
| Beef flavor | 0.6 | 0.21 | 0.5 | 0.34 | 1.65 | |
| Paprika | 0.15 | 0.33 | 0.24 | 0.19 | 0.91 | |
| Chicken flavor | 0.18 | 0.11 | 0.19 | 0.28 | 0.76 | |
| Vegetable flavor | 2.2 | 0.8 | 0.12 | 0.6 | 3.72 | |
| Brand IV (FF) | | | | | | |
| seafood flavor | 0.14 | 0.19 | 0.28 | 0.36 | 0.97 | |
| Creamy shrimp flavor | 0.17 | 0.22 | 0.18 | 0.19 | 0.76 | |

Detection Limit: 0.5µg/kg
Accuracy: 99.1%
Precision: 0.98.4%
Bias: -0.2 µg/kg

**Table 5.** Aflatoxins content (µg/kg) in dried vegetables

| dried vegetables | Results (µg/kg) | | | | | |
|---|---|---|---|---|---|---|
| | **AFB1** | **AFB2** | **AFG1** | **AFG2** | **AFB1+ AFB2+ AFG1+ AFG2** | **(ES) No 7136/2010** |
| Brand IV (FF) Seafood flavor | 0.17 | 0.25 | 0.16 | 0.17 | 0.75 | 4 |

Detection Limit: 0.5µg/kg
Accuracy: 99.1%
Precision: 0.98.4%
Bias: -0.2 µg/kg

**Table 6.** Iodine values for liquid seasoning present in different studied brands of instant noodles

| Palm oil | Iodine (μg/g) | Codex Standard 210-1999 for palm oil |
|---|---|---|
| Brand IV, Creamy shrimp flavor | 2.86 ± 0.04 | 50-55 g/100 g = 0.5-0.55 g/g |
| Brand I, Chicken curry flavor | 1.13 ± 0.03 | |
| Brand I, Special chicken flavor | 1.45 ± 0.02 | |
| Brand I, Vegetable flavor | 0.96 ± 0.03 | |

**Table 7.** Acid values (mg/g) for liquid seasoning present in different studied brands of instant noodles

| Palm oil | Acid value(mg/g) | Codex Standard 210-1999 for palm oil |
|---|---|---|
| Brand IV, Creamy Shrimp flavor | 1.96 ± 0.02 | 10 mg KOH/g |
| Brand I, Chicken curry flavor | 3.8 ± 0.02 | |
| Brand I, Special chicken flavor | 4.6 ± 0.03 | |
| Brand I, Vegetable flavor | 5.8 ± 0.03 | |

## 4. Conclusions

The seafood flavor and shrimp flavor of Brands I and IV were the most contaminated flavors with respect to heavy metals. Cadmium (Cd) and lead (Pb) contents of Brand IV exceeded the Egyptian standards (ES No. 71361/2010). Brands I and IV were the only brands that included liquid seasoning oil in various flavors. Brand IV had the highest contamination of Cd, Pb, and Hg in its two flavors, while the highest As contamination was found in the chicken curry flavor of Brand I. There was no available data in (ES) No 7136/2010 about heavy metals in liquid oil seasoning except for Pb, which had the limit of 0.10 ppm. In any case, the studied samples fell above this limit, except for Brand I with special chicken flavor. Brand II, with processed tomato flavor, had the highest contamination of aflatoxins, a level which was higher than (ES) No 7136/2010. Other brands were below that limit. Brand I with special chicken flavor had the lowest aflatoxin contamination, and can thus be considered as the safest brand for aflatoxin contamination. Brand IV shrimp flavor had the highest iodine value, while the least value for it was found in Brand I vegetable flavor, which was below the limit stated by the Codex (0.5-0.55 g/g). Brand I vegetable flavor had the highest acid value of 5.8 ± 0.03mg/g, while Brand IV shrimp flavor had the lowest acid value. Brand IV had a high iodine value and low acid value, which suggested no rancidity and no lipid peroxidation when compared to Brand I, with low iodine value and high acid value, suggesting it would be more susceptible to rancidity and lipid peroxidation. The consumption of instant noodles is still a risky choice because some flavors contain aflatoxins and heavy metals at levels exceeding the Egyptian standard limits. In addition, the risk of lipid oxidation for liquid seasoning oils is evident. Extensive studies on experimental animals are recommended to evaluate noodle safety and health hazards associated with consumption of spices and liquid seasoning oils.

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