J Biochem Tech (2018) 9(4): 81-88
ISSN: 0974-2328

Evaluation of Okra Pods Quality (*Abelmoschusesculentus* L.) After Reduction of Pesticides

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Received: 07 September2018 / Received in revised form: 12 December 2018, Accepted: 19 December 2018, Published online: 22 December 2018

Abstract

This study was conducted to evaluate okra pods' quality to reduce the pesticides' residues of indoxacarb, fenarimol, acetamiprid and chlorfenapyr by using different processes such as water washing, boiling, steaming and chemical solution for 3, 5 and 7 min. After that, the treated okras were cooked. Chemical analyses were done in okra pods raw okras after different processes. The mineral contents were determined in okra pod as raw materials. Peroxidase, color, percent of penetration depth (firmness) and zinc retention were assayed in okra after the treatments. Moreover, sensory properties and color were estimated in okra after cooking. Finally, a hazard assessment of pesticide residues in okra pods was determined after and before the cooking. The findings illustrated that the highest amount of protein and crude fiber (18.62 and 13.85%) followed by ash content and total fat were 7.21 and 2.64% respectively in okra pod as raw material. Moreover, Potassium, Calcium, Phosphorus, Magnesium, and Sulphur were higher than Sodium and Iron. The chemical composition of okra was decreased after the processing (boiling, steaming and chemical solution). These decreases might be caused by the physiological and metabolic activities within the cells of the okra pods, and at the same time due to proteolysis which was the breakdown of protein, and also the crude fiber content converted the fiber cellulose to carbohydrate. Most of the processing treatments, particularly cooking, significantly decreased the pesticide residues. Hazard index (Hi) before processing treatments ranged from 1500 to 2400. Although, Hi values were decreased after the processing treatments to reach 300, 360, 8.6 and 80, and the adverse health effects on consumers were potential. Also, the effect of the treatments on the quality characteristics of okra fruits was tested. Boiling and chemical solution improved the quality of okra pods; RAPID percentage significantly decreased to reach 3.96%; and greenness, firmness, and Zinc intake were significantly enhanced in chemically blanched okra. From the results, it could be recommended that the boiling and chemical solution treatment of okra pods to reduce the pesticide residues of indoxacarb, fenarimol, acetamiprid, and chlorfenapyr give the best results than the steaming treatment.

Keywords: Okra, Pesticide Residues, Blanching, Cooking, Quality.

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Introduction

Okra (*Abelmoschusesculentus*) is the greatest widely common and used species of the family Malvaceae (Naveed, Khan and Khan, 2009) and an economically significant vegetable crop mature in tropical and sub-tropical regions of the world (Andras et al., 2005; Saifullah and Rabbani, 2009). Okra plant was earlier time has contained in the genus Hibiscus. Later, now it was specified to *Abelmoschus*, which is prominent from the genus Hibiscus (Aladele, Ariyo and Lapena, 2008). Okra is a significant vegetable crop mature extensively in India and for the dominance of many insect pests; versus insecticides have been utilized (Singh, Kiran Kumar and Tanwar, 2004; Sinha and Sharma, 2007). Whilst combat the insect pest problem and for better yield and quality, a lot of pesticides are utilized by the vegetable growers. Insecticides are repeatedly used throughout the entire time of the growth stage (Sardana, 2001).

Fruit and vegetables are an important constituent of a human diet may be due to the supply of essential nutrients and vitamins needed for the proper bodily functions (Oguntibeju, Truter and Esterhuyse, 2013). Unfortunately, fruit trees and vegetables are often infested by insects and fungal diseases during their growth. In order to control losses of crops and to maintain their high quality, pesticides are used widely. The food crops treated with pesticides had contained unpredictable quantities of these chemicals; therefore solutions for decontamination of agricultural products must be searched for, especially as consumers worry about the harmful effects of chemicals on human health.

Pesticides not only persist in the vegetables but also contaminate water and soil. It then enters the food chain and exhibits its presence in human blood through the consumption of foodstuffs and water. Besides, pesticides participate in environmental contamination, biodiversity losses and deterioration of natural habitats (Subhani et al., 2001). The instances of pest recovery, development of resistance to pesticides, secondary pest outbreaks, and destruction of non-target species have also been recorded and the agriculture sector is being highlighted as the most important source of adverse effects (Sattler, Kächele and Verch, 2007).

Insecticides are also extensively used for controlling many agricultural pests. Contamination of vegetables with pesticide residues has been reported by several investigators may be due to the accumulation of pesticide residues in consumable vegetables due to the random utilize of in pesticides especially at the mature stage and non-adoption of safe waiting time (Kumari et al., 2003; Kumari et al., 2002). A number of pesticides that are commonly found in our food have been identified to adversely affect human health.

Preparation and preservation of food always subjected to heat treatment be controlled upon the nature of food and the aim of processing. The loss of pesticide residue during heat processing may be caused to evaporation, co-distillation, thermal degradation which vary with the chemical nature of the individual pesticide. Heat treatments are specific in many methods had contained pasteurization, boiling, cooking etc., (Sharm et al., 2005).

Many processing ways utilized in households and at food plants have been reported to affect, albeit differently, the pesticide level in foods. Most food processing techniques and ways generally decrease residual quantities of pesticides, but some may cause a greater in the residue content may be due to the concentration influence. Water processing as washing with water or soaking in various solutions, chemicals and cleaners are reported to be much effective in decreasing the level of pesticides (Angioni et al., 2004; Ling et al., 2011; Chandra et al., 2015). Thermal processing treatment such as pasteurization, blanching, boiling, cooking, steaming, canning etc., have been found to decrease effectively different pesticides (Balinova, Mladenova and Shtereva, 2006; Kumari, 2008; Kaushik, Satya and Naik, 2009).

The aim of this study was achieved to the effect of processing on the quality of okra pods (*Abelmoschusesculentus* L.) after the reduction of pesticides. Treatment okra with water boiling steam and chemical solution for 3, 5 and 7 min to reduce the pesticides after that all treatments were cooked for 20 min using 700 ml of water. Peroxidase (PID), color and zinc mineral were estimated in okra after and before cooking, and also sensory properties were assayed in okra after cooking.

Materials and Methods

Materials:

Okra pods (*Abelmoschusesculentus* L.) was purchased from Horticulture Institute, Agricultural Research Center, Giza-Egypt

Pesticide formulations, commercial Avaunt (Emulsifiable Concentrate (EC), 15 % of indoxacarb); Rubigan (EC, 12 % of fenarimol); Mospilan (Soluble Powder (SP), 20 % of acetamiprid) and Challenger (Suspension Concentrate, (SC) 36 % of chlorfenapyr), were obtained from the local market.

The chemical solution consisted of 250 ppm zinc chloride, 0.5 % potassium meta bi-sulfite, 0.1 % magnesium oxide and 0.1 % sodium bicarbonate according to Gupta *et al*. (2005).

Methods:

Treatment of okra pods to reduce pesticides and cooking:

Before okra any treatments, three representative replicates were taken for determination of obviously initial pesticide residues. Okra fruits were immersed for 3 min in a homogenized mixture of commercial formulations of the tested pesticides at the rate of application 3.75, 3, 5 and 16.2 g/100 L water of active ingredients of indoxacarb, fenarimol, acetamiprid and chlorfenapyr, respectively. Then, the treated okra fruits were taken out and left to dry at room temperature. After that, successive processing treatments were estimated for the removal of pesticide residues. The first treatment was washing by entirely immersing the pods in tap water for 5 min after that the okra pods were divided into three groups. Each group was subjected to one of three different processing treatments:

Okra treatment with blanching in 700 ml boiling tap water for 3, 5 and 7 min to give three treatments (B3, B5, and B7).

Okra treatment with steaming for 3, 5 and 7 min using a traditional steam pot with 3-liter capacity and equipped with a pored barrier (S3, S5, and S7).

O Okra treatment with blanching chemical solution for 3, 5 and 7 min using 700 ml of the chemical solution (M3, M5, and M7).

After each treatment, the okra pods were cooked for 20 min using 700 ml of water. Three representative replicates were taken from each treatment for residues analysis.

Chemical analysis and manorial content of okra pods after and before reduction of pesticides

Chemical analysis (protein, fat, crude fibers and ash) were estimated in okra pods after as raw material and before treatments to reduce pesticides according to AOAC (2005). Total carbohydrate was calculated by the difference method (summing the values of crude protein, crude fiber, ash, and crude fat and subtracting the sum from 100) according to McDonald *et al.* (1973).

Minerals content phosphorus (P), sodium (Na), sulphur (S), calcium (Ca), iron (Fe), potassium (K) and magnesium (Mg), were examined in okra pods as a raw material using the atomic absorption spectrophotometer (3300 Perkin-Elmer) and also, sodium (Na) and potassium (K) contents were determined by Flame Photometer (CORNING 400, serial No. 4889.UK) as described by AOAC (2005).

Determination of peroxidase in okra pods after treatments:

Samples of each treatment were taken for peroxidase (POD) inactivation analysis by spectrophotometer (HITACHI, ü-1900) at 470 nm according to Alvarez *et al.* (2015). The mixture of reaction consists of 2.9 ml substrate and 0.1ml crude enzyme extract. Units of peroxidase activity were calculated according to Kokkinakis and Brooks (1979) using the following equation:

$$Units/min/ml = \frac{OD/minX\ dilutoin\ factorX1000}{ml\ enzyme\ used\ in\ assay}$$

Color measurements of okra pods after and before cooking.

Color measurements were tested by a spectrophotometer (MOM, 100 D, Hungary) according to Sahin *et al.* (2011). The obtained x, y, and z values were converted to Hunter a, b and L color coordinates according to Francies (1995).

Zinc mineral content of okra after treatments.

Zinc content was determined for control and blanched samples in chemical solution by atomic absorption spectrophotometer, BUCK scientific (210VGP). Working standard was prepared by further dilution of 1000 ppm stock solution of Zn metal (0.5 to 1.5 ppm). The calibration curve was constructed by plotting absorbance versus concentration. The samples were overnight digested by sulfuric and perchloric acids and subjected to determination by atomic absorption according to AOAC (2005).

Percentage of penetration depth of okra pods after treatments.

The percentage of penetration depth was measured by recording the depth in (mm), to which a conical probe 0.5 cm in diameter penetrate in the pod under a weight of 50g using a digital penetrometer (AP4, Dresden, Germany). The probe and the weight were mounted on the vertically moving column.

Sensory characteristics of okra pods after cooking.

Okra samples were cooked separately with no spice added other than table salt, adopting the recipe of Aworh *et al.* (1980). Cooked okra samples were estimated by ten panelists using a multiple comparison variation analysis. Panelists rated the cooked samples for color, odor, texture, taste and overall acceptability (10-9: very good, 8-7: good, 6-5: acceptable and < 5 refused). Each panelist was provided with fresh okra samples in coded identical small bowls and water for rinsing the mouth in between tasting.

Hazard assessment of pesticides residues in okra pods

Hazard on consumers resulted from exposure to contaminated okra pods was calculated using the following equations:

EDI = $\mathrm{C} \times \mathrm{F/D} \ \times \mathrm{W}$ according to FAO (2002).

Where:

EDI= Estimated Daily Intake of pesticide, C= pesticide residue concentration (mg/kg),

F= the annual consumption (g) of okra per person, D = number of days per year (365),

W= mean of body weight (60kg).

Hi $= \mathrm{EDI/ADI}$ According to USEPA (2015).

Where:

Hi = Hazard index,

ADI = Acceptable Daily Intake set by Codex Alimentarius Commission (FAO/WHO, 2004).

Statistical analysis:

The data obtained in the present study were analyzed by ANOVA. For all analyses, when a considerable various ($p < 0.05$) was detected in some variable, the results means test was applied to estimate the difference among the samples. The results were analyzed with the aid of the software SAS System for Windows SAS (2008).

Results and Discussion

Chemical composition and minerals content in okra pods:

Protein, total fat, crude fiber, ash content, and total carbohydrates were determined in okra as raw material and the results are reported in Table (1). From the resultant, it could be noticed that the highest content in protein and crude fiber (18.62 and 13.85%) followed by ash content and total fat which had contained 7.21 and 2.64% respectively. These results occurred with Cook et al. (2000) who observed that the fresh okra are less in energy (20 per 100 g), no fat, high in fiber, and also both of okra skin (mesocarp) and seeds are rich with high amounts of zinc (80 mg/g), respectively. Moreover, it had contained nearly 30% of the vitamin C, from10 to 20% of folate and about 5% of vitamin A and also the recommended levels were from16 to 29 mg, from46 to 88 mg and from14 to 20 RAE, respectively. Proteins of okra play a particularly significant role in human nutrition may be caused characterize a protein's biological value and also the amino acid contents, their proportions, and digestibility by humans (Ewa, Agnieszka and Adametal, 2011). Okra has named "a perfect villager's vegetable" that may be caused it was had contained rich high amounts of natural dietary fiber and distinct seed protein balance which had contained high amounts from both of lysine and tryptophan amino acids (Sanjeet et al., 2010). Okra also had contained rich amounts from total carbohydrates and vitamins (Arapitsas et al., 2008; Dilruba et al., 2009), and it plays an essential role in the human diet may be due to high amounts in nutrition value (Saifullah and Rabbani, 2009; Kahlon, Chapman and Smith, 2007). Consumption of immature okra plants is significant as fresh fruits, and it can be used in various forms (Ndunguru and Rajabu, 2007). Moreover, immature okra can be utilized as boiled, fried or cooked (Akintoye, Adebayo and Aina, 2011).

Minerals content phosphorus (P), sodium (Na), sulphur (S), calcium (Ca), iron (Fe), potassium (K) and magnesium (Mg), were estimated in okra pods as a raw material and the finding are reported in the same table. The results illustrated that the potassium, calcium, phosphorus, magnesium, and sulphur were higher (103.0, 66.0, 56.0, 53.0 and 30.0 mg/100g dry weight, respectively) than sodium and iron were 6.9 and 0.35 mg/100g dry weight. Okra has contained about 17% of the principal elements as Potassium, Sodium, Magnesium, and Calcium. Meanwhile, Iron, Zinc, Manganese, and Nickel also have been found (Moyin-Jesu, 2007).

Table 1: Chemical composition and minerals content in okra pods:

Chemical analysis	g/100g dry weight	Minerals content	mg/100g dry weight
Protein	18.62	Phosphorus	56.0
Fat	2.64	Sodium	6.9
Crude fiber	13.85	Sulphur	30.0
Ash	7.21	Calcium	66.0
Total carbohydrates	56.58	Iron	0.35
		Potassium	103.0
		Magnesium	53.0

Protein, total fat, crude fiber, ash content, and total carbohydrates were estimated in okra pods after different processing (boiling, steaming and chemical solution) for 7 min and the findings are tabulated in Table (2). The results showed that the protein content of okra decreased after processing (boiling, steaming and chemical solution) from 18.62 to 17.74 to 17.35 to 17.44%, respectively. Adetuyi *et al.* (2008) reported that the decreases of protein after processing might be attributed to the physiological and metabolic activities within the cells of the okra pods and at the same time due to proteolysis which was the breakdown of protein.

The crude fiber content of okra after different processing was reduction than okra pods as raw material. The reduction in fiber might be as a result of the conversion of the fiber cellulose to carbohydrate Adetuyi *et al.* (2008).

Table 2: Chemical composition of okra pods after different processing for 7 min:

Chemical analysis	Boiling	Steaming	Chemical solution
Protein	17.84	17.35	17.44
Fat	2.34	2.25	2.31
Crude fiber	12.02	12.20	12.14
Ash	7.32	7.26	7.30
Total carbohydrates	60.48	60.94	60.81

The effect of processing treatments on quality parameters of okra pods:

Quality parameters of blanched and cooked okra samples were illustrated in Table (3 and 4). The peroxidase activity on untreated okra samples was 5760 unit/min/ml. The residual activity of peroxidase enzyme (RAPID) percentage ranged between 7.69 to 6.12 for water blanching and 5.85 to 4.12 for steam and 4.25 to 3.96 for chemical solution treatments. Blanched okra in water for 3 min has significantly the highest value of RAPID. However, boiling with chemical solution significantly decreased RAPID percentage compared to the other treatments. This is might be due to the presence of divalent ions in a chemical solution which plays as an enzyme inhibitor during the blanching process. These results are consistent with Sat (2008) who stated that excessive levels of heavy metals can be inhibiting a large number of enzymes.

The negative values of (a) parameter refer to the greenness color shade of okra samples. Washing of okra fruits increased the intensity of greenness color shade due to the removal of dirties and diffusion of water in air cells on the surface, which enhance the light reflectance. Water blanching for 7 min significantly decreased the greenness color due to the partial solubility of chlorophyll Mg++ in blanching water. Also extended steam blanching (7 min) significantly affected the value due to an increase of chlorophyll degradation as a result of the high heat transfer rate of condensing steam and consequently accelerated chlorophyll destruction. The use of salts especially zinc in blanching water for 3 min significantly enhanced the greenness color shade of blanched okra compared with the other blanched samples. Blanching of 5 minutes in water or steam had a significant effect on increasing the lightness values (L) when compared with the blanching of 3 minutes in chemical solution. According to Canjura *et al.* (1999), zinc ions react with chlorophyll degradation products (pheophytin and pyropheophytin) and keep the green color quality of green vegetables. A similar effect was also achieved by using sulfur dioxide compounds due to an effect on chlorophyllase (Shams El-Din and Shouk, 1999).

Concerning firmness (measured as penetration depth in mm), unprocessed okra (c) was semi-rigid and showed a penetration depth of 35 mm and zinc content 38.85 ppm. As seen, washing treatment reduced penetration depth of okra by 27.44% reduction and increased firmness of fruit. The reason for such behavior could be referred to as increased cell turgor (inside pressure) due to water absorption. Blanching in chemical solution treatments and in water for 3 min caused a little significant effect on cell walls structure since the increase in penetration depth did not exceed 178% of the control sample. Concerning zinc content, blanching of okra samples in a chemical solution containing salts increased zinc retention by 247.8 to 209.8%. Donato *et al.* (1999) reported that blanched vegetables with a high concentration of Zn solution for a short time revealed green color retention and improvement of texture.

Table (3): Changes in quality parameters of okra pods before cooking

Okra samples	RAPOD* (%)	Color			Penetration depth (%)	(%) Zn retention
		a	*b*	*L*		
Control	---------	10.23^{c}	14.74^{c}	38.23^{a}	100.0^{e}	100.0^{c}
Washed (W)	100	15.30^{a}	9.43^{e}	28.79^{d}	72.56^{f}	99.59^{c}
Boiling in water (B)						
B3	7.69^{a}	09.29^{c}	14.25^{c}	32.37^{c}	172.0^{d}	
B5	6.69^{b}	10.81^{c}	18.40^{a}	39.39^{a}	346.4^{b}	
B7	6.12^{b}	09.69^{d}	11.59^{d}	33.16^{c}	384.0^{a}	
Steaming (S)						
S3	5.85^{b}	09.71^{c}	16.16^{b}	35.22^{b}	222.7^{c}	
S5	4.99^{b}	10.50^{c}	12.09^{d}	37.91^{ab}	235.8^{c}	
S7	4.12^{c}	08.19^{d}	16.38^{b}	33.82^{c}	248.1^{c}	
Blanching in chemical solution (M)						
M3	4.25^{c}	12.17^{b}	15.90^{b}	36.92^{b}	154.9^{d}	244.4^{a}
M5	4.16^{c}	10.70^{c}	15.69^{b}	28.45^{d}	159.9^{d}	247.8^{a}
M7	3.96^{c}	11.43^{c}	16.65^{b}	29.51^{d}	178.0^{d}	209.8^{b}

Means with the same letter in the same column are not significantly different (at $p<0.05$) under the same heat treatment.
* RAPID =residual activity of peroxidase enzyme

The variety in the color which measurable of fresh, blanched and dried okra may be due to the leaching of chlorophyll into blanch water and subsequent degradation of green chlorophyll and also oxidative of pigments when the long time exposure to heat, sunlight and oxygen through drying Falade and Omojola (2010).

Table 4: Changes in color parameters of okra pods after cooking

Okra samples	Color		
	a	*b*	*L*
B3	8.51^{c}	9.33^{d}	24.46^{f}
B5	9.56^{b}	11.83^{c}	27.40^{e}
B7	9.61^{b}	20.54^{a}	34.53^{b}
S3	8.69^{c}	11.27^{c}	30.13^{d}
S5	9.95^{a}	17.27^{b}	31.74^{c}
S7	7.79^{c}	16.51^{b}	31.47^{c}
M3	10.15^{a}	16.63^{b}	34.18^{b}
M5	10.36^{a}	17.54^{b}	31.79^{c}
M7	8.30^{c}	20.76^{a}	36.13^{a}

Sensory evaluation of cooked okra pods.

Sensory evaluation of cooked okra after blanching boiling water, steaming and blanching chemical at different times was evaluated and the results are presented in Fig. (1). From the results, it could be noticed that the cooking of okra after blanching boiling water the sensory properties showed that the color, odor, and taste were acceptability after blanching 3, 5 and 7 min, respectively. Meanwhile, the texture was lower after blanching in 5 and 7 min than 3min.

The results from sensory properties of cooking okra showed that the okra treatment steaming after 3 min was acceptability in texture and color, meanwhile, after 5 and 7 min were acceptability in taste and odor. Poor rating of steaming okra may be able to be due to the absence of the volatile oil components through long time exposure to air during steaming.

The blanching chemical solution was significantly enhanced the green color and texture of samples when compared with other treatments. Blanched okra in a chemical solution for 3 min recorded the highest scores in color, odor, texture, taste and subsequently overall acceptability traits. The lowest sensory evaluation scores were possessed by blanched okra in a chemical solution for 5 min and 7 min and they were refused for taste and overall-acceptability. This is implied that, whenever the time of chemical blanching treatment increased, the sensory traits were badly affected.

Generally, okra pods have shown that the basic beneficial characteristics and had contained in rich amounts from the beneficial properties in the field of prevention and lateness in the first of chronic diseases and the saving of vitamins and enzymes essential for suitable body function (Aman, Schieber and Carle, 2005).

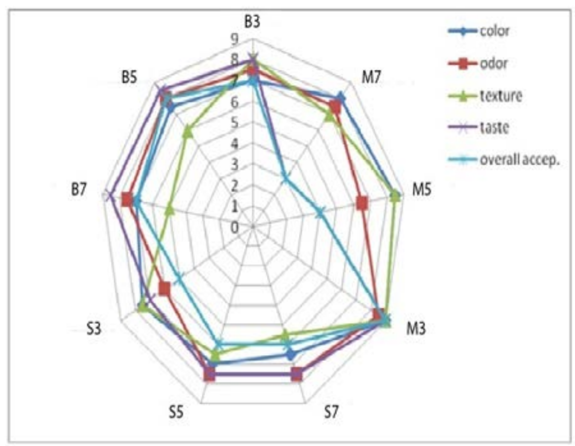

Fig. (1): Sensory evaluation of cooked okra pods.

Hazard assessment of pesticides residues in okra pods after and before cooking:

Worldwide request for food is growing mainly may be caused to increasing peoples. One side effect of becoming better food production is increased applied of pesticides to protect crops from damage infested by insects and fungi and low completion from weeds (Paker, 2013)

Estimated Daily Intake of pesticides (EDIs) before washing and after processing treatments are reported in Table (5) and after treatments cooking okra are reported in Table (6). Chlorfenapyr residues before washing treatment showed the highest EDI (45 mg/kg, bw) while acetamiprid revealed the lowest exposure level (4.8 mg/kg, bw). Although the exposure levels after processing treatments were valuably decreased, the EDI values were still higher than the ADIs.

Table 5: EDI and Hi values of pesticide residues after processing treatments on okra pods

Treatments	Indoxacarb		Fenarimol		Acetamiprid		Chlorfenapyr	
	EDI	Hi	EDI	Hi	EDI	Hi	EDI	Hi
Initial residues	15	1500	24	2400	4.8	68.6	45	1500
Washed	5.4	540	7.2	720	2.4	34.3	4.2	140
B3	4.2	420	6.6	660	1.2	17.1	4.2	140
B5	3.6	360	9.6	960	1.8	25.7	4.2	140
B7	4.8	480	9.6	960	1.8	25.7	5.4	180
S3	7.8	780	21	2100	4.8	68.6	8.4	280
S5	7.2	720	11.4	1140	3.0	42.9	9.0	300
S7	6.6	660	13.2	1320	3.0	42.9	15.0	500
M3	4.2	420	6.6	660	1.2	17.1	6.6	220
M5	3.6	360	9.6	960	1.8	25.7	6.6	220
M7	4.8	480	9.6	960	1.8	25.7	6.6	280

USEPA (2015) reported that, if Hi value is equal to or less than 1, then harmful health impacts are not expected. However, if Hi is larger than 1, then adverse health effects have probably occurred. Hi of the tested pesticides before processing treatments ranged from 1500 to 2400. These results indicated the expected high level of risk to consumers of okra fruits. However, Hi values were effectively decreased after processing treatments, particularly for acetamiprid after cooking treatments (Hi = 8.6). Hi values of the tested pesticides after processing treatments ranged from (300 to 900) indoxacarb, (360 to 2100) for fenarimol, (8.6 to 68.6) for acetamiprid and (80- 500) for chlorfenapyr. This finding revealed that the adverse health effects on consumers are highly expected even though the processing treatments reduced residues effectively.

Although acetamiprid residues in certain treatments reached half of the MRL, Hi values of these treatments (8.6) revealed a potential hazard on the consumers. Despite MRLs of indoxacarb and fenarimol are 2 times higher than MRL of chlorfenapyr, Hi values at the same levels of residues, showed that indoxacarb and fenarimol could be 3 times hazardous than chlorfenapyr. The obtained results highlight the importance of routine programs of pesticides residues monitoring in foodstuff besides the need of more studies concerning the hazard assessment on human consumers (FAO/WHO, 2004).

Definition of the acceptable daily intake (ADI) is evaluated the amount of the essential materials in food that can be fed daily forever without danger to human health. Therefore the hazard risk index (HRI) is applied to estimate the possibility health risk from consumption of pesticide sediment including foodstuff. Moreover, the evaluated daily intake (EDI) from pesticide sediment in a presented food is obtained by multiplying the sediment level in the food by the amount of that food consumed. EDI of pesticide sediment should be less than its established ADI (Darko and Akoto, 2008).

Risk evaluate was carried out to use the ADI and the EDI. The EDI was calculated from the average consumption/person/ day and the pesticide residues information. The percent EDI to ADI ratio was calculated as (EDI/ADE) × average adult weight (55 kg) (Lee et al., 2009).

Table 6: EDI and Hi values of pesticide residues after processing treatments and cooking of okra pods

Treatments	Indoxacarb		Fenarimol		Acetamiprid		Chlorfenapyr	
	EDI	Hi	EDI	Hi	EDI	Hi	EDI	Hi
B3	4.2	420	4.8	480	0.6	8.6	4.2	140
B5	4.2	420	4.8	480	0.6	8.6	6.0	200
B7	3.6	360	3.6	360	0.6	8.6	4.2	140
S3	3.6	360	6.0	600	1.2	17.1	3.0	100
S5	3.0	300	3.6	360	0.6	8.6	2.4	80
S7	9.0	900	13.8	1380	3.6	51.4	4.8	160
M3	3.0	300	3.6	360	0.6	8.6	3.6	120
M5	3.0	300	3.6	360	0.6	8.6	3.4	100
M7	3.0	300	3.4	340	0.6	8.6	3.2	120
ADI (mg/kg bw)	0.01		0.01		0.07		0.03	
EU-MRL (mg/kg)	0.02		0.02		0.2		0.01	

Conclusion

From the obviously results it could be noticed that the detected pesticides after treatments are not harmful to consume for humans. Also, special precaution should be taken with possible total exposure to these chemicals from different foods in the future. Whilst, monitoring the residues of pesticides in food continuously is essential may be caused by possible health effects. Therefore, promoting the consumption of traditional vegetables as okra could provide good sources beneficially nutritional values. Furthermore, this vegetable can also be applied as an absolutely necessary tool when it comes to decreasing the prevalence of malnutrition.

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