Benha Veterinary Medical Journal 40 (2021) 152-156

Official Journal Issued by Faculty of Veterinary Medicine

Benha Veterinary Medical Journal

Journal homepage: https://bvmj.journals.ekb.eg/

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Original Paper

Chemical residues in emulsion type meat products (Frankfurter and Luncheon)

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ARTICLE INFO

Keywords

Chemical residues
Emulsion type meat products
Heavy metal
OCPs
OPPs
Trenbolone
Zeranol

Received 07/02/2021
Accepted 05/03/2021
Available On-Line 01/04/2021

ABSTRACT

In this study a grand total of 150 samples of emulsion type meat products Luncheon and Frankfurter (75 of each) were collected from Giza governorate supermarkets, Egypt. The examined samples were subjected to determination of levels of antibiotics, zeranol and trenbolone hormones, heavy metals (Cadmium (Cd), lead (pb), Zinc (Zn) and Arsenic (As)), and pesticides (organophosphorus (OPPs) and organochlorine (OCPs)) residue. The study proved that the absence of antibiotics, OPPs and arsenic residue levels in all examined samples. Zeranol residues were undetectable in frankfurter samples, but it was detected in twenty-five luncheon samples (33%) with mean value of 0.0732 ppb. Trenbolone residues were detected in 67% of luncheon and frankfurter with mean values of 0.2213 ppb and 0.1776 ppb, respectively. Lead residues were present in fifty samples of luncheon and frankfurter (67%) with mean value of 0.0504 ppm and 0.0165 ppm, respectively. The highest incidence of cadmium residues was 67% of frankfurter with mean 0.0044 ppm, while relatively lower incidence of cadmium residues was found in luncheon samples with mean 0.0019 ppm. Zinc residues were recorded in all samples of frankfurter with mean value of (0.597 ppm), while it was recorded in 50 samples of luncheon (67%) with mean value of 0.3839 ppm. The PP-DDT pesticide residues were found with highest level in all examined luncheon samples with mean value 3.638 ppm, while lower level was reported in frankfurter with mean value 1.69856 ppm. Methoxychlor residues were recorded in all examined luncheon samples with mean value 59.02398 ppm, but not detected in frankfurter. Aldrin residues were detected in all examined frankfurter samples with mean value 0.756 ppm. Endrin residues were not recorded in luncheon and frankfurter. The PP-DDT residues were recorded in all examined luncheon samples with mean value 0.445 ppm. In this study three types of OCPs were recorded in luncheon samples, whereas two types of OCPs only recorded in frankfurter samples.

1. INTRODUCTION

Meat and meat products are integral parts of the daily diet for many people, due to tradition variety, reasonable prices, versatility satiety value and taste.

Human around the world are exposed to chemical contaminants, during their lifetime, contaminants such as antibiotics, hormones, heavy metals, and pesticides (organophosphorus compounds and organochlorine compounds).

The use of antibiotics that might result in deposition of residues in meat, milk and eggs must not be permitted in food intended for human consumption (Nisha, 2008). The residues of anabolic agents or their metabolites in meat, fish and other foods of animal origin may cause adverse toxic effects on consumer health (EFSA, 2007). The hormone residues in meat results in an adverse effect on human health such as disrupting hormone balance causing developmental problems (Glbraith, 2002; and Sato, 2005). The veterinary drugs with anabolic effects, even some used for therapeutic and prophylactic purposes, and to enhance the ability of the animal to benefit from the feed that being used. Many of them are prohibited in the European Union and only allowed to be used in specific situation under strict control measures (Reig and Toldra, 2008).

The main treats to human health are contamination with heavy metals especially lead, cadmium, and mercury. Heavy metals become toxic when they are not metabolized by the body and accumulated in tissues (WHO, 2011). Among the pollutants generated by industry and urbanization, heavy metals and various pathogenic bacteria are the most dangerous, because they can cause serious health problems to human population as a consequence of natural and anthropogenic activity, heavy metals are present in the environment, so that people come into contact with them especially consumption of food (Harmanesu *et al.*, 2011). A large number of pesticides may potentially be used in the production of agriculture crop commodities, leading to indirect exposure of animals through feed and the potential for residues in animal products. Also, pesticides can be taken up by livestock in their feed or water and may be incompletely eliminated at the time of slaughter (Mac Lachlan and Bhula, 2008). The substances, having anabolic effect like androgens estrogens, antibacterial substances like sulfonamides and tetracycline, organochlorine pesticides (OCPs), and heavy

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metals can enter farm animal tissues and their residues could remain in the animal treated derived foods, constituting risk (Croubles *et al.*, 2004).

This study was planned to evaluate the residues of antibiotics, hormones, organophosphorus and organochlorine pesticides as well as some heavy metal residues in emulsion type of meat products as luncheon and frankfurter.

2. MATERIAL AND METHODS

2.1. Collection of Samples

A total of 150 samples of emulsion type meat products (Luncheon and Frankfurter) (75 of each) were collected from Giza governorate supermarkets. Samples were transferred into ice box to Animal Health Research Institute (Giza branch laboratory) as fast as possible without delay and kept at -18º C for further investigations of residues.

2.2. Determination of residues in meat products

2.2.1. Antibiotics residues:

The method was carried out according the Heitzman (1990) using microbiological assay

2.2.2. Anabolic steroid residues (Zeranol and Trenbolone)

Using RIDASCREEN Zeranol and Trenbolone Immunoassay

2.2.3. Heavy metals (Lead, Cadmium, Zink and Arsenic)

It was carried out according to Staniskiane et al. (2006) and Chawdnury et al. (2011) using Atomic Absorption flam emission Spectrophotometer model AAS- 240FS Varian Australia. The samples were digested by wet digestion method.

2.2.4. Pesticides (organophosphorus and organochlorine)

The detection of pesticides was carried out according to JAOAC (1968, 1974, 1973) using Gas Chromatography (GC).

3. RESULTS

This study revealed that absence of antibiotics, organophosphorus pesticide (OPPs) and arsenic residues in all examined samples and zeranol residues in frankfurter but present in luncheon was 33%. The trenbolone residues were recorded in examined frankfurter and luncheon samples with incidence of 67% for each of them.

The residues of hormones were illustrated in table (1), it was shown that zeranol residues were not recorded in all examined frankfurter samples whereas; incidence of trenbolone was 67%. The range of trenbolone was 0.1-0.4 ppb with average value 0.1776 ± 0.0142. Also, it was showed that 25 of luncheon samples 33% and 50 samples 67% had zeranol and trenbolone residues, respectively. The average of zeranol was relatively lower 0.0732 ± 0.0041 ppb than trenbolone residues in the same products 0.2213 ±0.0213 ppb. The range of zeranol and trenbolone were 0.04- 0.1 ppb and 0.07-0.4 ppb, respectively.

Results in table (2) illustrated that the mean value ppm of the lead, cadmium residues in frankfurter samples which were 0.0165 and 0.0044 with minimum values 0.01 and 0.001 and maximum values 0.024 and 0.008 respectively. The arsenic residues were not detected in any of examined frankfurter samples.

Table 1 Hormone mean residues in examined Frankfurter and Luncheon samples (No. of each = 75)

Samples	Zeranol (ppb)						Trenbolone (ppb)					
	+ve samples		Min	Max	Mean	SE±	+ve samples		Min	Max	Mean	SE±
	No	%					NO	%				
Frankfurter	0	0%	0	0	0	0	50	67%	0.1	0.4	0.1776	0.0142
Luncheon	25	33%	0.04	0.1	0.0732	0.0041	50	67%	0.07	0.4	0.2213	0.0213

Table 2 Heavy Metal Mean Residues in examined Frankfurter and Luncheon Samples (No. of each = 75)

Heavy metal residues	Parameter		Meat product	
			Frankfurter	Luncheon
Lead (ppm)	+ve samples	No	50	50
		%	67%	67%
	Min		0.01	0.035
	Max		0.024	0.064
	Mean		0.0165	0.0504
	SE		0.0008	0.0017
Cadmium (ppm)	+ve samples	No	50	25
		%	67%	35%
	Min		0.001	0.001
	Max		0.008	0.003
	Mean		0.0044	0.0019
	SE		0.0003	0.0002
Arsenic (ppm)	+ve samples	No	0	0
		%	0%	0%
	Min		0	0
	Max		0	0
	Mean		0	0
	SE ±		0	0
Zinc (ppm)	+ve samples	No	75	50
		%	100%	67%
	Min		0.515	0.38
	Max		0.074	0.389
	Mean		0.597	0.3839
	SE		0.0116	0.0004

The positive residues samples for either lead or cadmium were 50 samples with a percentage 67%.

Concerning zinc residues mean value ppm were 0.597 with a minimum value 0.515 and maximum value 0.74. All examined frankfurter samples contained zinc residues, and also **table 2** shown that lead, cadmium, and arsenic residues mean values ppm in luncheon samples were 0.0504, 0.0019 and 0 with minimum values, 0.035, 0.001, 0.0 and maximum values 0.064, 0.003 and 0.0 respectively. The positive samples of both lead and cadmium were 50 (67%) and 25 (33%), respectively. The zinc residues were recorded in 50 luncheon samples 67%, the zinc mean residues was 0.3839 ppm.

As shown in table (3**)** results recorded that, the sixteen of organochlorine pesticides (Alfa- BHC, gama- BHC, delta-BHC, heptachlor, aldrin, heptachlor epoxide, endoslufan, dieldrin, PP. DDE, endrin, endosulfan 11, PP. DDD, endrin aldehyde, Endosulfan sulfate, PP-DDT, and Methoxychlor) standardized for residues in examined frankfurter samples were not detected except two types, aldrin and PP-DDT. The value of PP-DDT (1.69856 ppm) was higher than aldrin (0.756 ppm).

The only three detected OCP in examined luncheon samples were PP-DDD, PP-DDT and Methoxychlor, whereas, the other thirteen OCP mentioned were not detected. The values of PP-DDD, PP-DDT and Methoxychlor (ppm) were 0.445, 3.636 and 59.02398, respectively

Table 3 Organochlorine Pesticide (OCPs) Residues by (GC) in examined Frankfurter and Luncheon samples (No. of each = 75)

Name of OCP	Frankfurter		Luncheon	
	Detected residues (ug/ul)	Calculated residues (ppm)	Detected residues (ug/ul)	Calculated residues (ppm)
1- Alfa - BHC			-	-
2- Gama - BHC			-	-
3- Delta - BHC			-	-
4- Heptachlor			-	-
5- Aldrin	5.58762 e^{-2}	0.756	-	-
6- heptachlor epoxide			-	-
7- Endosulfan			-	-
8- Dieldrin			-	-
9- PP DDE			-	-
10- Endrin			-	-
11- Enosulfan 11			-	-
12- PP. DDD			1.20897 e^{-1}	0.445
13- Endrinaldehude			-	-
14- Endosulfan sulfte			-	-
15- PP-DDT	1.69856	1.69856	9.89020 e^{-1}	3.638
16- Methoxychlor	-	-	59.02398	59.02398

Table 4 The residual levels of hormones (Zeranol and trenbolone), heavy metals (Lead , cadmium , zinc and arsenic) and organochlorine pesticides compared with Maximum Residue Limits (MRLs) in examined Frankfurter and luncheon samples

Residue Name	Frankfurter samples (No = 75)		Luncheon samples (No = 75)	
	Mean	MRLs	Mean	MRLs
Zeranol	0	0.05	0.0732	0.05 (ppb)
Trenbolone	0.1776	2	0.2213	2 (ppb)
Lead	0.0165	0.02	0.0504	0.02 (ppm)
Cadmium	0.0044	0.05	0.0019	0.05 (ppm)
Zinc	0.597	60	0.3839	60 (ppm)
Arsenic	0	-	0	-
Aldrin	0.756	0.2	ND	-
PP-DDT	1.69856	5	3.638	5 (ppm)
PP-DDD	ND	5	0.445	5 (ppm)
Methoxychlor	ND	0.01	59.02398	0.01 (ppm)

ND = Not detected

4. DISCUSSION

In recent years, hormones and hormone like substances have been recently used in livestock production to obtain a high yield performance in a shorter period of time. These anabolic agents are used to increase the weight gain, to improve the food efficiency, strong protein and to decrease fatness, however, depending on the use of anabolic agent in animal feed, anabolic residues that may occur in meat and meat products, may cause risks to human health **(Asiya and Akzira, 2016).** This residue level of trenbolone in frankfurter was within the MRLs recommended by **Codex 1997 and EC 1999** (2ppb). The mean value of trenbolone (0.1776 ppb) recorded in this study was relatively higher than that recorded by **(Bülent 2005)** which is 0.11 ppb whereas zeranol residues 1.32 ppb. The same author recorded zeranol and trenbolone residues in minced meat 0.94 and 0.1 ppb respectively. The frankfurter was processed from frozen meat then cooked, this explains the absence of zeranol in frankfurter samples, this result in agreement with that reported by **(Mykola, 2020)**. The residues of both trenbolone and zeranol not exceed MRLs recommended by codex 1997 and EC 1999 in luncheon samples. The world health organization declared that zeranol residues should not exceed 0.05 ppb in daily human food **(Codex Alimentarious 1997)**. In recent years, increasing attention has been paid to the role of hormones in breast cancer etiology, following reports that heightened levels of endogenous hormones and exposure to exogenous hormones and other endocrine disrupting chemicals through food and the environment are associated with increased breast cancer risk **(Keeve and Tylor 2015).** Fortunately, the mean values of lead and cadmium meets the MRLs recommended by **(EU 2006)**. Lead was found in (100%) and 56% in examined beef samples **(Montip *et al.*, 2015)**. The meat products in Egypt is made from imported frozen beef meat, **(Hassouba, *et al.*, 2007)** found that the examined frozen meat in Luxor Egypt had cadmium and lead residues mean values (ppm) 0.005 and 0.022, respectively whereas, the same author found that the minced meat had cadmium and lead mean residues values were 0.012 and 0.064 (ppm) respectively. This explains the presence of heavy metal residues in examined meat products. Zinc concentration in this study ranged from 0.05 to 0.027 mg/kg which is very low as compared to the recommended daily allowance of 60 mg/ day as indicated by **(Koréneková *et al.*, 2000)**.All metals are toxic at certain levels of intake, however, in contrast to elements such as arsenic chromium, copper, selenium and zinc that have useful biological functions, cadmium, lead and mercury play no useful role and their intake should be limited to avoid organ damage **(Parekhan *et al.*, 2014; Kramer *et al.*, 1983)**. Lead is one of the most dangerous chemicals to children. The most important effect of long-term exposure is neurotoxicity, particularly during the first 2–3 years of life when early development of the central nervous system occurs. Exposure to lead during this time increases the risk of mild mental retardation, attention deficit hyperactivity disorder and other developmental disabilities. (**Pronczuk de Garbino J, ed. (2004**) .In adults, it, causes: adverse blood effects, reproductive dysfunctions; damage to the gastrointestinal tract; nephropathies, damage to the central as well as the peripheral nervous system and interferences in the enzymatic systems that synthesis the Heme group **(Sierra and Hardisson, 1991; Rubio et al., 2006).**Cadmium accumulate in kidneys and it has an extremely long biological half-life in humans in the order of 20 – 30 years **WHO (2009).**The aldrin residues in frankfurter samples was exceed the MRLs recommended by both **(EC 2004)** 0.05 ppm and **FAO/WHO** 2016 (0.2 ppm). **(Shehat *et al.*, 2017)** found aldrin residues 0.014 ppm which was within the fore mentioned MRLs.. Luncheon like frankfurter is emulsion type meat product with large caliber casing with higher amount of low-cost non-meat extended plant ingredients **(Gunter Heinze and Peter Hautzinger 2007)**. The DDT in luncheon meat products was relatively higher than recorded in frankfurter 3.636 and 1.69856 ppm respectively, it may attributed to the increase of plant ingredients in luncheon more than frankfurter which may be responsible for the relative increase of DDT. According to **EC 2004 and FAO/WHO 2017** MRLs for PP-DDT is 5 ppm in meat, it is mean that the examined meat products (frankfurter and luncheon) were not exceed the fore mentioned MRLs. On the other hand, the Methoxychlor residues were recorded only in examined luncheon samples with value (59.02398 ppm). The MRLs of Methoxychlor was recommended by **EC 2004 and FAO/ WHO 2017** is 0.01 ppm. Accordingly, the Methoxychlor exceed this limit in examined luncheon

samples. It is obvious from present data that three types of OCP residues recorded in luncheon samples whereas two types only recorded in frankfurter samples. The public health toxicity of organochlorine pesticides (OCPs) is mainly due to stimulation of the central nervous system. Cyclodines, such as the GABA antagonists' endosulfan and lindane, inhibit the calcium ion influx and Ca- and Mg ATPase release of neurotransmitters **(Mathew, 2012)**. Organchlorines act as endocrine disrupting chemicals (EDCs) by interfering with molecular circuitry and function of the endocrine system **(Sohail *et al.,* 2004).**This study revealed that as shown in **table 4**, the residues level of trenbolone in frankfurter was within the MRLs recommended by **(Codex 1997 and EC 1999)** (2 ppb), while the residue levels of both trenbolone and zeranol not exceed the MRLs recommended by **(codex 1997 and Ec 1999)** (0.05) ppm for zeranol and 2ppb for trenbolone in luncheon samples. The mean values of lead and cadmium meets the MRLs recommended by **(E4 2006)** (0.02 ppm) for lead and (0.05 ppm) for cadmium. The zinc concentration in this study ranged from 0.05 to 0.027 mg/kg which is very law as compared to the recommended daily allowance of 60 mg/day as indicated by **(Korenekova et al., 2000)**. The aldrin residue level in frankfurter samples was exceed the MRLs recommended by **EC 2004 where** 0.05ppm and FAO/WHO 2016 where 0.2 ppm. According to **(EC 2004)** and **(FAO / WHO 2017)** MRLs for PP-DDT is (5 ppm) in meat, it means that the examined meat products (Frankfurter and Luncheon) were not exceeding the fore mentioned MRLs. The MRLs of Methoxychlor recommended by **(EC 2004)** and **(FAO / WHO 2017)** is 0.01 ppm. Accordingly, the Methoxychlor exceeds this limit in examined luncheon samples.

5. CONCULOSIONS

It can be concluded from the present study that analysis of emulsion type meat products (luncheon, frankfurter) indicated such meat products were contaminated with hormones, heavy metals, and organochlorine pesticides while these products were free from antibiotic residues and organophosphate pesticide residues when they are analyzed. Although most of fore mentioned residues occurred at very low concentration in the examined samples, they may accumulate to higher levels in human beings who consume these products.

It is recommended: 1- Strict analysis of meat products at different localities and the presence of antibiotic, hormone, heavy metals, and pesticides residues 2- The products above the recommended permissible limits should be refused. 3 Meat products must be labeled by official organization to indicate the levels of antibiotics, hormones, heavy metals, and pesticides.

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