Concepts of Dairy & Veterinary Sciences

DOI: 10.32474/CDVS.2020.03.000166

ISSN: 2637-4749

Research Article

Prevalence of Some Chemical Hazards in Some Meat Products

Fahim A Shaltout[1]*, Mohamed AH El Shater[2] and Wafaa MA Haza[3]

[1]*Food Hygiene Department, Faculty of Veterinary Medicine, Benha University, Egypt*

[2]*Food Hygiene Dept, Animal Health Research Institute, Egypt*

[3]*Food Hygiene Dept, Animal Health Research Institute, Egypt*

***Corresponding author:** Fahim A Shaltout, Food Hygiene Department, Faculty of Veterinary Medicine, Benha University, Egypt

Received: February 10, 2020 **Published:** February 24, 2020

Abstract

In an attempt to determine the prevalence of some chemical hazards in various meat product thus, by measuring the residual levels of lead, cadmium and nitrite in such product, a total number of 60 random samples (15 of each) of minced meat , beef burger, sausages and luncheon were haphazardly gathered from a varied supermarkets and retailers in Benha City at Kalubia Governorate, Egypt to be chemically analyzed by means of spectrophotometer. From the achieved results, it was detected that the mean values of residual levels of Pb in the inspected samples of minced meat, beef burger, sausages and luncheon were 0.06 ± 0.01, 0.11 ± 0.01, 0.16 ± 0.01 and 0.23 ± 0.01 mg/kg, respectively, while those of Cd were 0.03 ± 0.01, 0.07 ± 0.01 , 0.12 ± 0.01 , and 0.15 ± 0.01 mg/kg, and finally those of nitrite were not detected, 39.81 ± 2.24, 27.59 ± 1.65 and 62.07 ± 2.51 (ppm), respectively. The obtained findings were complied with the acceptable limits of heavy metals residues and residual nitrite level recommended by Egyptian Standards.

Keywords: Chemical hazards; Meat products; Lead; Cadmium; Nitrite

Introduction

Hazards are defined as an agent that are probably to cause illness or injury to the human within absence of its control or and are classified into three types: biological, chemical and physical hazards. Whereas, biological hazards are of great consideration as the contaminated foods can cause widespread illness outbreaks, chemical hazards may also cause food-borne diseases [1] seeing that, most of the chemical hazards have long term health problems for the consumers of food products [2]. Chemical hazards are most often associated with raw materials, ingredients and personnel practices that include heavy metals, pesticides, veterinary medicines, cleaning compounds, allergens and some food additives [3]. Heavy metal pollutants can contaminate meat product in the course of processing through raw material, spices, packaging materials and packaging method and it considered as a great concern risk for food safety and human health because of their toxic nature at comparatively minute concentrations and/or their ability to accumulate within the body organs Santhi *et al.* [4]. Also, there considered as a potential carcinogen besides causing several disorders in the cardiovascular system, nervous system and skeletal system Zhuang *et al.* [5]. Lead and cadmium can enter the meat supply in restricted amounts from environmental impacts in which the major source maybe the industrial practices. Another origin, is from contamination during the processing from the contact with machinery, tools, and installations or after some technological processes (as smoking, drying and salting) Manea *et al.* [6]. Some food additives as nitrite may also be hazardous if present in excessive or toxic amounts [7]. Nitrite have been conventionally utilized as curing agents in the production of some meat products for improvement of the quality as well as the microbiological safety because it features a role in the development of the distinct flavor, the steadiness of the red color and shield against lipid oxidation. Moreover, it shows significant bacteriostatic and/or bactericidal activity against several spoilage microorganisms and it hinder the growth and toxin production by Clostridium botulinum [8]. Meanwhile, using of nitrite in food has been clouded by doubts in which it could react with amines in the gastric acid and form carcinogenic nitrosamines, leading to various cancers production [9].

Material and Methods

Collection of Samples

A total 60 random samples of meat products represented by 15 samples of each of minced meat , beef burger, sausage and luncheon that were collected from different supermarkets and shops in Benha City, Kalubia governorate, Egypt were subjected to chemical examination to estimate levels of lead and cadmium in addition to nitrite level.

Determination of Heavy Metals

The collected samples were examined for determination of their lead and cadmium levels on the basis of wet weight (mg/Kg).

Washing procedures according to [10].

Digestion technique according to Tsoumboris & Papodoulou [11].

Preparation of blank and standard solutions according to Shibamoto& Bjeldanes, [12].

Quantitative determination of heavy metals: Absorbency of lead and cadmium was directly recorded from the digital scale and their concentrations were calculated according to the following equation: C=R x (D/W) Where, C= Concentration of the element (wet weight). , R= Reading of digital scale of AAS., D= Dilution of the prepared sample and W= Weight of the sample. Determination of residual nitrite level according to [13].

Results

Table 1: Statistical analytical results of lead levels (mg/Kg) in the examined samples of meat products (n=15).

Meat Products	Min	Max	Mean ± S.E*
Minced meat	0.01	0.09	0.06±0.01++
Beef burger	0.02	0.17	0.11±0.01++
Sausage	0.02	0.25	0.16±0.01++
Luncheon	0.07	0.38	0.23±0.01++

S.E* = Standard Error of Mean

++ = High Significant Differences (P<0.01)

The achieved findings in Table 1 clarified that the lead levels (mg/kg) in the tested samples of meat product were ranged from 0.01 to 0.09 at a mean value of 0.06±0.01 for minced meat , 0.02 to0.17 at a mean value 0.11±0.01 for beef burger, 0.02 to 0.25 at a mean value 0.16±0.01for sausage and 0.07 to 0.38 at a mean value 0.23±0.01 for luncheon. Also, there were a highly significant differences (p <0.01) between the examined samples, as appeared in Table 1. Furthermore, the detectable samples above the acceptable limit stipulated by [14] were 5 samples (8.3%) from all the studied samples as declared in Table 2. Results obtained in Table 3 declared that the Cd levels (mg/kg) in the studied samples were ranged from 0.01to 0.04 with a mean values of 0.03±0.01for minced meat samples, 0.01 to 0.15 with a mean values of 0.07±0.01 for beef burger, 0.01 to 0.19 with a mean values of 0.12±0.01 for sausage and 0.02 to 0.27 with a mean values of 0.15±0.01 for luncheon. Also, there were a highly significant differences (p <0.01) in Cd values between the examined samples. Wherein, 6.7% of the studied samples were above the permissible limits stipulated by [14] for Cd level, as declared in Table 4.

Table 2: Acceptability of the examined samples of meat products based on their contamination levels of lead (n=15).

Meat Products	Lead (PL)*	Accepted		Unaccepted	
		No	%	No	%
Minced meat	< 0.1	15	100	0	0
Beef burger	< 0.1	14	93.3	1	6.7
Sausage	< 0.1	13	86.7	2	13.3
Luncheon	< 0.1	13	86.7	2	13.3
Total		55	91.7	5	8.3

*Egyptian Standards "ES" (2010)

Table 3: Statistical analytical results of cadmium levels (mg/Kg) in the examined samples of meat products (n=15).

Meat Products	Min	Max	Mean ± S.E*
Minced meat	0.01	0.04	0.03±0.01++
Beef burger	0.01	0.15	0.07±0.01++
Sausage	0.01	0.19	0.12±0.01++
Luncheon	0.02	0.27	0.15±0.01++

S.E* = Standard Error of Mean

++ = High Significant Differences (P<0.01)

Table 4: Acceptability of the examined samples of meat products based their contamination levels of cadmium (n=15).

Meat Products	Cadmium (PL)*	Accepted		Unaccepted	
		No	%	No	%
Minced meat	< 0.05	15	100	0	0
Beef burger	< 0.05	14	93.3	1	6.7
Sausage	< 0.05	14	93.3	1	6.7
Luncheon	< 0.05	13	86.7	2	13.3
Total		56	93.3	4	6.7

*Egyptian Standards "ES" (2010)

It is evident from findings recorded in Table 5 that the mean values of nitrite levels (ppm) in the investigated samples of meat product were 62.07±2.51 for luncheon samples, 27.59±1.65 for sausage samples and 39.81±2.24 for beef burger samples. Meanwhile, nitrite was not detected in all the examined minced meat samples. Also, the differences between the assessed samples of meat products as a result of types of the products were significantly differences (p<0.05). Depending on the MPL of nitrite levels stipulated by [15] all the tested samples of meat product were accepted except only one luncheon sample (1.7%) was unaccepted, as declared in Table 6.

Table 5: Statistical analytical results of nitrite contents (ppm) in the examined samples of meat products (n=15).

Meat products	Min	Max	Mean ± S.E*
Minced meat	-	-	-
Beef burger	17.1	65.3	39.81±2.24+
Sausage	12.8	43.5	27.59±1.65+
Luncheon	25.6	103.2	62.07±2.51+

S.E* = Standard Error of Mean

+ = Significant Differences (P<0.05)

Table 6: Acceptability of the examined samples of meat products based on their nitrite contents (n=15).

Meat Products	Nitrite (PL)*	Accepted		Unaccepted	
		No	%	No	%
Minced meat	< 100	15	100	0	0
Beef burger	< 100	15	100	0	0
Sausage	< 100	15	100	0	0
Luncheon	< 100	14	93.3	1	6.7
Total		59	98.3	1	1.7

*Egyptian Standards "ES" (2005)

Discussion

Generally, chemical hazards in meat products can originate from 1. Unintentionally added chemicals (Agriculture chemicals as pesticides and animal drugs, Plant chemicals as cleaners, sanitizers, oils and lubricants and Environmental contaminants as heavy metals) 2. Naturally occurring chemical hazards: as products of plant, animal, or microbial metabolisms such as aflatoxins, etc. 3. Intentionally added chemicals (preservatives, food additives, processing aids, etc.) [1]. Heavy metals are chemical items, that can't be broken down or diminished in the course of heat treatment and it can promote multiple hazards on human health that may be acute or chronic lethal or sub lethal toxicity Shaltout *et al*. [16] Meat processing can provide a doable supply of heavy metals contamination in the ultimate products additionally the improvement in the food production and processing technology are increasing the probabilities of food contamination with numerous environmental pollutants, particularly heavy metals Lukáčová – Anetta *et al*. [17]. Results achieved in Table 1 clarified that the mean values of lead levels (mg/kg) in the tested meat product samples were 0.06 ±0.01, 0.11±0.01, 0.16±0.01 and 0.23±0.01 for minced meat, beef burger sausage and luncheon samples, respectively. Also, there were a highly significant differences (p <0.01) between the investigated products. This findings were almost identical to that obtained by Zahran- Dalia & Hendy- Bassma [18] (0.18± 0.13ppm) for sausage samples but exceeding that obtained Adejumo *et al.* [19] who recorded that lead can't be detected in any of the studied samples of meat product and additionally under that obtained by Meslam-Ebtsam [20] (0.13±0.01mg/kg) in minced meat. Absorption of ingested lead may constitute a serious risk to public health specially in young children who considered at high risk to lead toxicity, owing to their ability to effectively lead absorption leading to retardation of mental and physical development Karovicova & Kohajdova [21]. Meanwhile, lead toxicity in adult ends up in GI tract damage, procreative capability dysfunction, nephropathies, central and peripheral nervous system damage, adverse blood effects due to interference to the enzymatic system that synthesize the HEME group. Rubio *et al.* [22]. In accordance with the safe and accepted permissible limit(<0.1ppm) specified by [14] for lead level in meat product it was expressed that out of the examined 60samples of meat products 8.3% (5 samples) were considered as unaccepted which including 0% (0-sample), 6.7%(1 samples), 13.3% (2 sample) and 13.3% (2 samples) for the assessed samples of minced meat, beef burger, sausage and luncheon, respectively as declared in Table 2. The excessive lead intake above the permissible limits leads to joints, muscles and nerve disorders other than cardiovascular /skeletal and renal problems [23].

Results obtained in Table 3 declared that the mean values of Cd levels (mg/kg) in the inspected minced meat, beef burger, sausage and luncheon samples were 0.03±0.01, 0.07±0.01, 0.12±0.01 and 0.15±0.01, respectively. Also, there were a highly significant differences (p<0.01) in Cd values between the examined products. This finding was nearly like those obtained Hoha *et al*. [24] (0.16±0.008mg/kg) and Zahran- Dalia & Hendy- Bassma [25] (0.11±0.8ppm) in luncheon samples. Although, higher findings were detected by Meslam- Ebtsam [26] (0.07±0.01mg/kg) for minced meat samples. Meanwhile, lower results were achieved by Shahat *et al*. [27] who showed that Cadmium wasn't detected on the examined samples of minced meat. It is obvious from the obtained findings that recorded in Table 4 that 6.7% of the total examined samples (4/60) were unaccepted in which the highest incidence of unacceptability of the inspected meat product samples was recorded in luncheon samples13.3% (2/15samples), followed by sausage and beef burger samples 6.7% (1/15 sample for both) this is due to the detected level of cadmium concentration which exceeds the permissible limit predetermined by [14] that was (<0.05ppm). Meanwhile, all the tested samples of minced meat were considered as accepted as the detected Cd levels were below the permissible limit. In humans, cadmium are known to develop a range of toxic effects at the side of carcinogenic and non-carcinogenic effects as oral exposure to high levels of cadmium has cause severe stomach irritation, leading to vomiting and diarrhea, whereas exposure to lower levels over time has been found to cause excretory organ damage, bone deformity and simply broken bones [28]. Also, exposure to Cd is associated with many other effects such as neurotoxic, genotoxic, carcinogenic, and teratogenic effects [29].

Using of nitrite in meat processing as preservatives has an essential role in overriding of meat spoilage as well as in in manufacturing safe and appetizing meat product with well keeping quality even at surrounding temperature [30]. Regarding to data obtained in Table 5 it is obvious that the nitrite content in the investigated meat products samples (ppm) varied from 25.6 to103.2 with an average of 62.07±2.51 for luncheon samples, 12.8 to 43.5 with an average of 27.59±1.65 for sausage samples, 17.1 to65.3 with an average of

39.81±2.24 for beef burger samples. Meanwhile, nitrite was not detected in all the tested minced meat samples while the highest nitrite level was detected in the examined luncheon samples followed by beef burger samples and the lowest nitrite level was detected in sausage samples. Also, the differences associated with the inspected samples of meat products as a result of types of the products were significantly differences ($p<0.05$). This results came in agreement with those reported by Ez –Eldain-Afaf & El-Nemr [31] who reported that the mean value of nitrite in the observed luncheon samples was (80±7.3ppm) but disagreed with lower findings attained by El-Zahaby [32] that was (17.68ppm) in the tested samples of beef burger and higher results detected by Nayel [33] who concluded that the mean value of nitrite level in the examined burger samples was (94.04 ± 5.20ppm) and Meslam-Ebtsam [34] that was (24.14ppm) in minced meat samples. The high residual levels of nitrites could be attributed to inappropriate production states and faulty or improper implementation of nitrite standard levels at meat product plant Rezaei *et al.* [35]. Nitrites are considered safe once used at accepted level but can perform a hazard when this level exceeded consequently, the increasing levels of nitrite are becoming an important problem for public health Cemek *et al.* [36]. The primary toxic impact of nitrite is the creation of methemoglobin by oxidation of hemoglobin, this compound is incapable of transporting oxygen in the blood, leading to a condition referred to as methemoglobenemia [37]. Also, the long-term toxicity of nitrites is expounded to their potential to form carcinogenic compounds within the food likewise as in the human body Andree *et al.* [38]. At which the residual nitrite can be regenerate to the nitro-sating agent which react with secondary amines and form carcinogenic compounds (carcinogenic N-nitrosamines) [39]. Results obtained in Table 6 indicating that based on the permissible limit of residual nitrite content specified by Egyptian standards [15] (<100 ppm) , out of the examined 60 samples of 98.3% (59 samples) were considered as acceptable while 1.7% (one sample) were categorized as unacceptable. The high nitrite level in few of the observed samples may be attributed to elusiveness through inaccuracy of its level during the processing of meat products in relation to prolongation of their shelf-life since, the most important aim of some producers is the economic income regardless to the adverse effect of the used preservatives on the consumers health Farag & Abd-El- Fatah-Noha [40].

Conclusion

The achieved results demonstrated a highly significant differences existed in the concentrations of lead and cadmium metals across the inspected meat product samples. Furthermore, out of the examined 60 samples5 and 4 samples were above the permissible limits provided by Egyptian standards for both lead and cadmium, respectively. Whereas, the highest level of unacceptability appears in luncheon samples. Consequently, full awareness is required in the prevention of exposure to such health hazards owing to the fact that the presence of heavy metals even in lower levels that not exceeding maximum permissible limits not guarantee the low risk of exposures especially that heavy metals firstly tend to accumulate in the human body and secondly is that they are taken from more than one source. Thus, the continuous exposure of lead and cadmium even in low concentrations may result in accumulation of such metals leading to serious threatened health hazards to consumers.

In addition, from the findings of this study, the concentrations of nitrite residues in the examined products were differed significantly and according to the MPL of nitrite content fixed by ES it was concluded that all the examined samples were accepted except only one luncheon sample. Taking into consideration the wide use of nitrites in processed meat accompanying the high rate of consumption of these products, it is very important to have a control regarding the amount of these substances in food**.** Therefore, it is recommended that a periodic monitoring of these products is important with respect to such chemical hazards that affecting human health.

Acknowledgment

Authors pleased to thank all members of the food control department, Faculty of Veterinary Medicine, Benha University and members of Animal Health Research Institute for their kind support and encouragement.

Conflict of Interest

No conflict of interest.

References

1. USDA "U.S. Department of Agriculture" (1997) Meat and Poultry Products Hazards and Control Guide. Food Safety and Inspection Services. HACCP-2, p. 1-58.
2. Islam GMR, Hoque MM (2013) Food Safety Regulation in Bangladesh, Chemical Hazard and Some Perception to Overcome the Dilemma. International Food Research Journal 20(1): 47-58.
3. NZFSA "New Zealand Food Safety Authority" (2012) Processed Meats Code of practice part 4: HACCP Application. Amendment 1.
4. Santhi DV, Balakrishnan A, Kalaikannan, and Radhakrishnan K T (2008) Presence of Heavy Metals in Pork Products in Chennai (India). Am J Food Technol 3(3): 192-199.
5. Zhuang PMB, McBride H, Xia N, and Li ZL (2009) Health Risk from Heavy Metals via Consumption of Food Crops in the Vicinity of Dabaoshanmine, South China. Sci Total Environ 407(5): 1551-1561.
6. Shahat M, Ammar S, RamzySM, and Baz AM (2017) Health Risk Assessment of Toxic Heavy Metals and Pesticides Residues of some Raw Animal Foods Collected from Egyptian Market. J Curr Sci Int 6(2): 421-430.
7. NZFSA "New Zealand Food Safety Authority" (2012) Processed Meats Code of practice part 4: HACCP Application. Amendment 1. http://www.foodsafety.govt.nz/elibrary/.
8. Govari M, Pexara A (2015) Nitrates and Nitrites in Meat Products. J Hellenic Vet Med Soc 66(3): 127-140.
9. Archer DL (2002) Evidence that Ingested Nitrate and Nitrite are Beneficial to Health. Journal of Food Prot 65(5): 872-875.
10. Frederick Kavanagh (2006) AOAC "Association of Official Analytical Chemists" Official Methods of Analysis (13th edn), Horwitz W. Academic Press, Washington, DC, USA.
11. Tsoumbaris P, Papadopoulou TH (1994) Heavy Metals in Common Foodstuff: Quantitative analysis. Bull Eniron Cntam Toxicol 53 (1): 61-66.
12. Shibamoto T, and Bjeldanes L F (2000) Heavy contents in Some Meat Products. Toxilo Envir Chem 42: 113-117.

13. Horwitz W (2016) AOAC "Association of Official Analytical Chemists" Official Methods of Analysis (17th Edn). Academic Press, Washington, DC, USA.
14. ES "Egyptian Standards" (2010) Maximum Levels for Certain Contaminants in foodstuffs. No 7136/2010, Egyptian Standards, Ministry of Industry, Egypt.
15. ES "Egyptian Standards" (2005) Egyptian Standards for Requirements of Minced Meat, No :1694. Egyptian Standards for requirements of beef burger, No :1688. Egyptian standards for requirements of sausage, No :1972. Egyptian standards for requirements of luncheon meat, No :1114.
16. Shaltout FA, Hashim FM, and El Nahas s (2015) Detection of Some Heavy Metals in Fish (Tilapia Nilotica and Claris Lazera) at Menofia Governorate. BVMJ 29(1): 124-128.
17. Lukáčová Anetta, Golian J, Massányi P, and Formicki G (2014) Lead Concentration in Meat and Meat Products of Different Origin. Scientific Journal for Food Industry 8(1): 43-47.
18. Zahran 2018 A, and Hendy Bassma A (2015) Heavy Metals and Trace Elements Composition in Certain Meat and Meat Products Sold in Egyptian Markets. International Journal of Sciences: Basic and Applied Research (IJSBAR) 20(1): 282-293.
19. Adejumo, OE, Pius SF, Odion JE, Silva BO, and Fajemirokum, T (2016) High Cadmium Levels in Cured Meat Products Marketed in Nigeria-Implications for Public Health. Asian Pacific Journal of Cancer Prevention 17(4): 1933-1936.
20. Meslam Ebtsam MAM (2018) Chemical Studies on Some Locally Manufactured Meat Products. Fac Vet Med 35(1): 58-65.
21. Karovicova J, Kohajdova Z (2005) Biogenic Amines in Food. Chemical Papers- Chemical Zvesti 59(1): 70-79.
22. Rubio C, Gonzalez Iglesias T, Rever C, Reguera JI, Gutierre AJ et al. (2005) Lead dietary Intake in a Spanish Population (Canary Islands). J of Agri and Food Chemist 53: 6543-6549.
23. Environmental Working Group (2010) Lead Compounds.
24. Hoha GV, Costăchescu Elena, Leahu Ana and Păsărin B (2014) Heavy Metals Contamination Levels in Processed Meat Marketed in Romania. Environmental Engineering and Management Journal 13(9): 2411-2415.
25. Hendy Bassma A (2015) Heavy Metals and Trace Elements Composition in Certain Meat and Meat Products Sold in Egyptian Markets. International Journal of Sciences: Basic and Applied Research (IJSBAR) 20(1): 282-293.
26. Meslam Ebtsam MAM (2018) Chemical Studies on Some Locally Manufactured Meat Products. Fac Vet Med 35(1): 58-65.
27. Shahat M, Ammar S, RamzySM, and Baz AM (2017) Health Risk Assessment of Toxic Heavy Metals and Pesticides Residues of some Raw Animal Foods Collected from Egyptian Market. J Curr Sci Int 6(2): 421-430.
28. (2008) ATSDR "Agency of Toxic Substance and Disease Registry" Toxicological profile for cadmium. Department of Health and Human Services, Atlanta, GA, USA.
29. (2009) EFSA " European Food Safety Authority " Scientific opinion of the panel on contaminants in the food chain on a request from the European Commission on cadmium in food. EFSA J 980: 1-139.
30. Skibsted LH (2011) Nitric Oxide and Quality and Safety of Muscle-Based Foods. Official Journal of the Nitric Oxide Society 24(4): 176-183.
31. Ez Eldain Afaf M, El Nemr SA (2016) Assessment of Nitrate and Nitrite Residual Levels in Some Meat Products. Egypt J Chem Health 2(2): 611-616.
32. EL-Zahaby DI (2013) Chemical Evaluation of Some Food Additives in Meat Products. Fac Vet Med, Benha Univ, Egypt.
33. Nayel MS (2013) Studies on Chemical Preservatives in Meat Products. Fac Vet Med, Benha Univ, Egypt.
34. Meslam Ebtsam MAM (2018) Chemical Studies on Some Locally Manufactured Meat Products. Fac Vet Med 35(1): 58-65.
35. Rezaei M, Shariatifar N, Jahed Khaniki G, Javadzadeh M (2013) Nitrite in Hamburgers in Arak, Iran. J Food Addit Contam 6(4): 285-288.
36. Cemek, M, Akkaya L, Birdane YO, Seyrek K, Bulut S et al. (2007) Nitrate and Nitrite Levels in Fruity and Natural Minerals Waters Marketed in Western Turkey. Journal of Food Composition and Analysis 20(3): 236-240.
37. Santamaria P (2006) Nitrate in vegetables: Toxicity, Content, Intake and EC Regulation. Journal of the Science of Food and Agriculture 86(1): 10-17.
38. Andrée S, Jira W, Schwind KH, Wagner H, and Schwägele F (2010) Chemical Safety of Meat and Meat products. J Meat Science 86(1): 38–48.
39. Honikel, KO (2008) The Use and the Control of Nitrate and Nitrite for the Processing of Meat products. Meat Science 78(1-2): 68-76.
40. Farag Hel S, Abd El Fatah Noha RM (2011) Assessment of Nitrite and Ascrbic Acid Salts Level in Some Meat Products Antir Public Health Significance. Assuit Vet Med J 57(129): 1-22.

DOI: 10.32474/CDVS.2020.03.000166