Chemical and microbial assessment of beef and chicken shawarma sandwiches in Ismailia governorate and its impact on consumer health

Amany M. Ahmed, Nagwa A. B. El-Hakem and Ghada A. Ibrahim

Food hygiene, Biochemistry and Bacteriology Research Unit, Ismailia Provincial laboratories, Animal Health Research Institute, Egypt

Abstract

A total of 40 random beef and chicken shawarma sandwiches samples (20 of each) from different fast food restaurants in Ismailia governorate were collected and examined chemically by estimation of moisture %, carbohydrate %, protein %, fat%, and lead values. The obtained results indicated that the mean values in the examined samples were 45.53 ± 0.12 - 45.44 ± 0.11 ; 25.38 ± 0.11 - 24.02 ± 0.07 ; 18.48 ± 0.04 - 18.44 ± 0.06 ; 9.21 ± 0.03 - 10.38 ± 0.04 and 0.106 ± 0.013 - 0.059 ± 0.008 ppm respectively, The results of this Study indicated that ready-to eat Shawarma Sandwiches have Pb values within the tolerance limit set by the EOS (2005).

The obtained results revealed that the mean values of aerobic plate count, Enterobacteriaceae and *Staph. aureus* counts of beef and chicken shawarma were $4.8 \times 10^4 \pm 3.6 \times 10^3$, $4.2 \times 10^4 \pm 2.8 \times 10^3$; $6.8 \times 10^2 \pm 0.2 \times 10^2$, $1.3 \times 10^3 \pm 0.2 \times 10^2$ and $5.2 \times 10^3 \pm 1.5 \times 10^2$, $3.6 \times 10^3 \pm 0.8 \times 10^2$ respectively.

Salmonella represented 10% of beef shawarma sandwiches samples and 15% of chicken shawarma. The isolated serotypes of Salmonella were *S. typhimurium* and S. enteritidis. The public health significance and the possible sources of contamination of shawarma sandwiches, as well as some recommendations to improve the quality of such food articles were discussed.

Key words: beef shawarma, chicken shawarma, heavy metals, lead, Bacterial contamination, salmonella, aerobic plate count, Enterobacteriaceae count, Staphylococcus count.

INTRODUCTION

Shawarma is one of the most ready to eat sandwiches sold in fast food restaurants in Egypt. It is a wrap of shredded meat (beef or chicken) prepared by alternately stacking strips of fat and pieces of seasoned meat on a rotating vertical skewer. The meat is roasted from the outside, while most of the inside remains rare. Shavings are cut off the block of meat for serving, and the remaining block of meat is kept heated on the rotating skewer.

Shawarma sandwiches are manipulated extensively during processing and therefore have a potential for high bacterial contamination levels on the surface and the depth of the meat. As a result, there is an increased risk of pathogens surviving and transferring not only by cross-contamination, but also by undercooking as observed in this kind of fast-food industry (**Nimri** *et al.,* **2014).**

Environmental pollution is a major global problem posing serious risk to man and animals. The development of modern agricultural technology and the rapid industrialization are among the foremost factors for environmental pollution. The environmental pollutants are spread through different channel, many of which finally enter into food chains of livestock and man (**Kaplan** *et al.,***2011).**Various anthropogenic activities such as burning of fossil fuel, mining and metallurgy, industries and transport sectors redistribute toxic heavy metals into the environment, which persist for a considerably longer period and are trans-located to different components in environment (**Kotwal** *et al.,* **2005)**

Lead is not an essential human element and it has no known beneficial or necessary function within living systems (**Daland, 2000).**It is a metabolic poison and a neurotoxin that binds to essential enzymes and several other cellular components and inactivates them (**Cunningham and Saigo, 1997).**Inhibiting oxygen and calcium transport and altering nerve transmission in the brain (**Daland, 2000).**Lead also interacts with several essential elements—notably calcium, iron, and zinc—and dietary deficiencies of both calcium and iron are known to enhance the absorption of lead (**Goyer, 1996).**Toxic effects of lead are seen on haemopoietic, nervous, gastrointestinal and renal systems (**Baykov** *et al.,* **1996).** In addition**,** Lead can be transferred to the fetus through the placenta (**Goyer, 1990).**Adults absorb approximately 5–15 % of ingested lead into the circulation; of this amount, less than 5 % is retained in the body. Young children can absorb considerably more 30–40 % of ingested lead; this explains their enhanced susceptibility to the potential effects of lead (**Goyer,1996).**
So, precautions should be taken to limit childhood exposure.

The importance of food as a vehicle for the transmission of several diseases has been documented, especially in developing countries where hygienic standards are not strictly followed or enforced (**Harakeh** *et al.,* **2005).** The knowledge of microbiology of meat and its products is very important to control the growth of undesirable microorganisms and retarding the conditions favourable for their growth and activity (**Farooq** *et al.,* **2013).**

Shawarma sandwiches beef or chicken are more consuming, combining with sedentary life style, are a major health risk factor as more quantity with less quality food can cause people to high prevalence of obesity, diabetes mellitus and coronary heart disease. Nutritional analysis is done to assist you in making the right food choices for your personal needs.

The purpose of this study was to determine, provide information and awareness about the shawarma sandwiches from chemical and microbial conditions and its impact on the consumer health.

MATERIAL AND METHODS

1- **Collection of samples:** A total of 40 random beef and chicken shawarma sandwiches (20 of each) were collected from different fast food restaurants in Ismailia governorate. The collected samples were directly transferred to Ismailia Provincial laboratory for further examination.

2- **Chemical examination:**

-**Moisture %, Carbohydrate %, Protein % and Fat%** were determined according to the **AOAC(2000).**

- **Lead assay:** Each sample was ground and homogenised according to (**Al-Baggou', 2002**). The digested samples were analyzed for lead by using Unicam 969AA spectrometer England according to (**Iwegbue, 2008**).

3- **Bacteriological examination:**

- **Preparation of samples:** according to **ISO, 6887-2, 2003** the shawarma sandwiches were taken under aseptic condition and 10 grams from each sample was transmitted to sterile blender jar containing 90 ml of sterile peptone water 0.1% to be homogenized .

- **Preparation of serial dilution:** Ten fold serial dilutions were prepared from homogenate 1/10 (original dilution) by transferring one ml to tube containing 9 ml of sterile peptone water.

- **Bacteriological count:**

Total aerobic plate count: (APHA, 2001) spreading technique using standard plate count agar, incubated at 37° c for 24- 48 hr.

Total Enterobacteriaceae count: (APHA, 2001) spreading technique using violet red bile glucose (VRBG) agar , incubated at 37°C for 24-48 hr.

Staphylococcus aureus **count: (FDA, 2002)** spreading technique using Baird-Parker agar incubated at 37° C for 24-48 hr. The presumptive *S.aureus* colonies were confirmed by coagulase test using staph. Kit (Oxoid).

- **Isolation of salmonellae (ISO, 6579, 2002**) enrichment in rappaport vasiliades at 35°C for 24 hr., platting on XLD agar at 42°C for 24 hr. The presumptive colonies were confirmed bio chemically and serologically.

4- **Statistical analysis:** The results are expressed as mean ± standard Error (SE). Data were statistically analyzed using statistical analysis system software (**SAS version 9.1, SAS Institute, Inc., 2003**).

RESULTS AND DISCUSSION

Table (1) clarifies the mean value of lead in meat and chicken meat shawarma sandwiches were 0.106 ± 0.013 and 0.059± 0.008 ppm, respectively, which is lower than that recorded by (**Morshdy *et al*., 2000; Iwegbue*et al*., 2008 and Hala and**

Shireen, 2009),while the results in this study were nearly close to those reported by **(Fatin ,1998; Sharkawy and Amal, 2003 and Essa *et al*., 2007)**.This approximate lead value obtained from beef and chicken shawarma sandwiches not exceeded the permissible limits 0.1mg/kg that was recommended by **EOSQS (2005)** for Pb level. In recent years, the dominant focus has been on effects of low level lead exposure related to child development and behavior **(Daland, 2000)**.

Table **(2)** represented the chemical analysis of examined beef and chicken shawarma sandwiches samples. The mean values of Moisture % were 45.53 ± 0.12 ; 45.44 ± 0.11 , Carbohydrate % 25.38 ± 0.11 ; 24.02 ± 0.07 , Protein% 18.48 ± 0.04 ; 18.44 ± 0.06 and Fat % 9.21 ± 0.03 ; 10.38 ± 0.04 respectively. The protein % was lower than that recorded by **(Sulieman *et al*., 2012).** The variation of protein content could be attributed to the type of meat and the additives used. High fat content have bad effect on consumer health.

Table **(3)** represent the bacteriological results of this study, the total aerobic plate count (APC) were ranged from 6 x 10^3 to 3.4 x 10^5 with mean value 4.8 x $10^4 \pm 3.6$ x 10^3 in beef shawarma while in chicken shawarma were ranged from 5.2 x 10^3 to 2.6 x 10^5 with mean value 4.2 x $10^4 \pm 2.8$ x 10^3 , The APCs were lower than that recorded by (**Odu and Akano ,2012**) and higher than that recorded by(**Nimri *et al.,* 2014**)
Despite the preparation of shawarma by heating, there were still pathogenic microorganisms observed on the samples enumerated. This is as a result of the fact that some of the observed microorganism can survive high cooking temperature to which Shawarma products is exposed which is not sufficient to eliminate harmful microrganisms (**Abdelhai *et al.,* 2015).** Shawarma showed poor microbiological quality since the raw meat used for the processing of Shawarma is of a low quality meat. The Enterobacteriaceae mean counts were 6.8 x $10^2 \pm 0.2$ x 10^2; 1.3 x $10^3 \pm 0.2$ x 10^2 in beef and chicken shawarma respectively. These results were similar to that recorded by **(Odu and Akano , 2012)** and lower than that recorded by (**Eman and Sherifa, 2012**). *S. aureus* is Gram positive cocci resistant to heat, drying. They produce heat stable enterotoxins that renders the food dangerous (**Prescott *et al.,* 2005**). The *Staph. aureus* counts were ranged from 1.5 x 10^3 to 9.3 x 10^3 with mean value 5.2 x $10^3 \pm 1.5$ x 10^2 in beef shawarma while in chicken shawarma were ranged from 1.8 x 10^3 to 8.3x 10^3 with mean value 3.6 x $10^3 \pm 0.8$ x 10^2.

Table (4) represented the percent of positive *Salmonella* microrganisms shawarma sandwiches in this study and they constituted 10 % and 15 % from beef and chicken Shawarma sandwiches, respectively. The identified strains were *S. typhimurium* in beef shawarma sandwiches and *S. typhimurium* and *S. enteritidis* in chicken shawarma. These results were in accordance with results of studies by many researchers in meat products **(Torky, 2004 ; Siriken *et al*., 2006 and Farooq *et al.,* 2013)** but higher than that recorded by **(Abdel-Rahman *et al.,* 2011 and Abdalhamid *et al*., 2013)** who couldn't detect *Salmonella.*

Conclusion and Recommendation

High quality meat less fat content has to be used to process shawarma sandwiches. Health education and intervention program that aim to promote a healthy diet is needed. Prevention is the best way to deal with lead poisoning. Made intensive efforts to remove sources of lead from food items must be done **.**

Table (1): Lead levels (ppm) in beef and chicken shawarma sandwiches samples relative to EOSQC, (2005).

Element (ppm)	Mean ± SE	EOSQC,2005
Pb in chicken shawarma	0.059± 0.008	0.1 mg/kg
Pb in beef shawarma	0.106± 0.013	

(EOSQC) Egyptian Organization for Standardization and Quality control.

Table (2): Proximate chemical analysis of examined beef and chicken shawarma

	Beef shawarma			Chicken shawarma		
	Min.	Max.	mean	Min.	Max.	Mean
Moisture %	40.35	49.65	45.53 ± 0.12	40.76	49.54	45.44 ± 0.11
Carbohydrate %	23.57	31.41	25.38 ± 0.11	21.58	27.42	24.02 ± 0.07
Protein%	16.34	19.43	18.48 ± 0.04	14.32	19.25	18.44 ± 0.06
Fat %	8.43	10.95	9.21 ± 0.03	8.98	11.47	10.38 ± 0.04

sandwiches samples   (N= 20 of each).

Table (3): **Statistical analytical results of bacteriological counts (cfu/g) of examined beef and chicken shawarma sandwiches samples (N= 20 of each).**

	Sample	Min.	Max.	Mean ± SE
Total bacterial count	B.	6×10^3	3.4×10^5	$4.8 \times 10^4 \pm 3.6 \times 10^3$
	C.	5.2×10^3	2.6×10^5	$4.2 \times 10^4 \pm 2.8 \times 10^3$
Enterobacteriaceae count	B.	2.3×10^2	1.7×10^3	$6.8 \times 10^2 \pm 0.2 \times 10^2$
	C.	7.5×10^2	2×10^3	$1.3 \times 10^3 \pm 0.2 \times 10^2$
Staph. aureus **Count**	B.	1.5×10^3	9.3×10^3	$5.2 \times 10^3 \pm 1.5 \times 10^2$
	C.	1.8×10^3	8.3×10^3	$3.6 \times 10^3 \pm 0.8 \times 10^2$

B- beef shawarma   C- chicken shawarma

Table (4): The incidence and Serotyping of isolated *salmonella* from examined beef and chicken shawarma sandwiches samples (N= 20 of each).

	Beef shawarma			Chicken shawarma		
	No.	%	Identified strains	No.	%	Identified strains
Salmonella	2	10%	- *S. typhimurium* (2)	3	15%	- *S. typhimurium* (2) - *S. enteritidis* (1)

No. - **No. of positive samples**

References

Abdalhamid, S. A.; Farj, A. A. and Ali, A. B. (2013): Bacterial Contamination of Ready to Eat Foods (Shawerma Sandwiches) in Misurata City, Libya. 2nd Int. Conf. on Env., Agr. and Food Sci. (ICEAFS'2013) May 6-7, 2013 Kuala Lumpur (Malaysia).
Abdelhai, M. H. ; Sulieman, A. M. E. and Babiker, E.R.B. (2015) : Some chemical and microbiological characteristics of shawerma meat product. J Food Nutr. Disor. 4:2.
Abdel-Rahman, H. A.; Soad, A. S. and Esmail, M. E (2011): Microbiological Quality of Shawerma at Fast Food Restaurants . SCVMJ , XVI (1) **.**
Al-Baggou, B. K. (2002): Neurobehavioral and Biochemical Changes Induced By Inter-action Between Cadmium And Some Insecticides In Mice.Ph.D. Dissertation, College of Vet. Med., Mosul University, Mosul, Iraq, pp. 35.
AOAC (2000): Association of Official Analytical Chemists Official methods of analysis, 11th edition. Washington, DC.
APHA (2001): American public health association Committee on Microbiological Methods for Foods. Compendium of methods for the microb. exam. of foods. 4.ed. Washington.

Baykov, B.D.;Stoyanov, M.P. and Gugova, M.L. (1996): Cadmium and lead bioaccumulation in male chickens for high food concentrations. Toxicol. Environ. Chem., 54: 155-159.

Cunningham, W. P. and Saigo, B.W. (1997): Environmental Science a Global Concern. 4th Edn., WMC Brown Publisher, New York, pp: 389.

Daland, R. J. (2000): Lead and human health. Ph.D. theses Prepared for the American Council on Science and Health (ACSH).

Eman, M. S. and Sherifa, M. S. ((2012): Microbiological Loads for Some Types of Cooked Chicken Meat Products at Al-Taif Governorate, KSA. World Applied Sci . J . 17 (5): 593-597, 2012.

EOS, (2005): Egyptian Organization for Standardization and Quality control "Detection of poisons and control. Report No. 1796.

Essa, H. H.; Ashraf, M. A. and Eman, E. S. (2007): Extermination of Some Heavy Metals Some Ready -to- Eat Meals in Assiut City. Assiut Vet. Med. J. Vol. (53), No. (113), April 2007

Farooq, A. ; Saqlain, A.; Zahid, A. B.; Adnan, S. A.; Rashid, M.; Maqsood. A.; Muhammad, F.; Abdul, W.; Muhammad, N. and Aqsa, I.(2013): Bacterial Contamination in Processed Chicken Shawarma (Meat) Sold in Various Parts of Lahore, Pakistan. *Pak. J. of Nut., 12: 130-134*

Fatin, S. H. (1998):"Heavy metals contaminating some ready to eat meat products."Vet. Med. J. Giza, 46(2): 177-182.

FDA, 2002: Food and Drug Administration. Bacteriological Analytical Manual. 9th Ed., AOAC International, Arlington, VA, USA.

Goyer, R.A. (1990): Transplacental transport of lead. Conference on Advances in Lead Research: Implications for Environmental Health.RTP, N.C. Environ. Health Perspect. 89:101–106.

Goyer, R.A. (1996): Toxic effects of metals. In Casarett and Doull's Toxicology: The Basic Science of Poisons, 5th ed. C.D. Klaassen, Ed. McGraw-Hill, New York.

Hala, Sh. M. and Shireen, M. N. (2009): Estimation of some heavy metals in chicken shawarma. Egypt. J. Comp. Path. & Clinic. Path. Vol. 22 No. 3 (July) 24 – 36.

Harakeh, S ; Yassinea, H.; Ghariosb, M.; Barbourc, E.;Hajjara, S.; El-Fadeld, M. ;Toufeilib, I. and Tannous, R. (2005) : Isolation, molecular characterization and antimicrobial resistance patterns of Salmonella and Escherichia coli isolated from meat-based fast food in Lebanon. Sci Total Environ 341: 33-44

ISO, 6579, 2002 : Microbiology of Food and Animal Feeding Stuffs—Horizontal Method for the Detection of Salmonella spp..

ISO, 6887-2, 2003 : Microbiology of Food and Animal Feeding Stuffs —Preparation of Test Samples, Initial Suspension and Decimal Dilutions for Microb. Exam.

Iwegbue, C.; Nwajei, G. and Ioyoha, E. (2008): Heavy metal residues of chicken meat and gizzard and turkey meat consumed in southern Nigeria Bulgaria." J. of Vet.Med. 11, 4: 275-280.

Kaplan, O.; Yildirim, N.C.; Yildirim, N. and Cimen, M.(2011): Toxic elements in animal products and environmental health. *Asian J. Anim. Vet. Adv.* 6: 228-232.

Kotwal, S. K., Sharma, R. K., Srivastava, A. K.(2005): Industrial pollutants and animal health a review.Indian J. Anim. Sci. 75: 713-722.

Morshdy, A. ; El. Sebaey, E. and Sallam, K. (2000): "Lead pollution in shawerma from Zagazig city, Egypt." AssiutVet.Med. J., 43 (85): 124-129.

Nimri, L. ; Abu AL-Dahab, F. and Batchoun, R. (2014): Foodborne bacterial pathogens recovered from contaminated shawarma meat in northern Jordan. J Infect Dev. Ctries 2014; 8(11):1407-1414.

Odu, N.N. and Akano, U.M.(2012): The Microbiological Assessment of Ready-To-Eat-Food (Shawarma) In Port Harcourt City, Nigeria. Nature and Science 2012;10(8) p 1-8.

Prescott, M. ; Harley, P. and Klein, D. A. (2005) : Microbiology 6th Edtn McGraw Hill. New York U.S.A. p.910.

SAS Institute (2003). SAS Proprietary Software. Re. 9.1. SAS Instit. Inc.: Cary, NC.

Shaheen , N . ; Shah, M . ; Khalique, A. and Jaffar, M. (2005): Metal levels in airborn particulate matter in Urban Islamabad, Pakistan." Bull. Env. Cont. Toxicol. 75: 739-746

Sharkawy, A. and Amal, A. (2003): "Lead and cadmium levels in some ready to eat meat products (shawerma and hamburger) at Assiut city."Assiut Vet. Med., 49 (99):105-112.

Siriken, B. ; Pamuk, S.; Ozaku, C. ; Gedikoghe, S. and Eyigor, M. (2006): A note on the incidences of Salmonella species, Listeria species and E.coli O157:H7 serotypes in Turkish sausage (soudjouck). Meat Sci., 72(1): 7.

Sulieman, A. E. ;Abdelhai, M. H. and Babiker, E. B. (2012): Some Chemical and Microbi. Characteristics of Agashi Meat Product. Food and Nut. Sci., 3, 851-856.

Torky, A. A. S.(2004): Trials for inhibition of some food poisoning microorganisms in meat products. Ph. D., Thesis, Fac. Vet. Med., Cairo University, Egypt.