



Investigating the Ways of Displaying Eggs, Dairy Products, and Meat in the Markets of Mosul City, Iraq

Omar A. Al-Mahmood* and Ali M. Najm

Department of Veterinary Public Health, College of Veterinary Medicine, University of Mosul, Mosul City, Iraq

*Corresponding Authors: Omar A. Al-Mahmood, E-Mail: omar.a.almoula@uomosul.edu.iq

ABSTRACT

The aim of the present study was to investigate ways of displaying food products of animal origin in the markets of Mosul city, to assess the level of applying of food safety practices in these markets. The results of the study showed significant proportions of food products (red meat, chicken, dairy products, eggs) offered in the markets of Mosul city (right and left sides) at room temperature. As out of the 400 food products of animal origin that were audited, 151 are offered for sale at room temperature which constitute 37.8% of the total audited samples. While 32.8% of the audited food products were offered for sale at refrigerator temperature. As for freezing, it was limited to red and white meat only, as the percentage of these products was 29.4% of the total samples preserved in this way. As 89% of the table eggs displayed for sale in the markets of Mosul city were at room temperature. The percentage of white meat preserved and displayed in the markets was 87%, by freezing method. There were no significant differences between the markets of the left and right-side regions in terms of displaying or preserving food products of animal origin at room temperature, refrigeration or freezing ($P > 0.05$). The public health surveillance system can have benefit from these results by noting the weaknesses in the food safety practices application in the markets of Mosul city, Iraq.

Keywords: Animal products, Food preservation, Food safety, Iraq, Markets, Mosul.

Original Article:

DOI:<https://dx.doi.org/10.21608/javs.2022.135967.1146>

Received :26 April, 2022.

Accepted :20 June, 2022.

Published in July, 2022

This is an open access article under the terms of the Creative Commons Attribution 4 (CC-BY) International License . To view copy of this license, visit:

<http://creativecommons.org/licenses/by/4.0>

J. Appl. Vet. Sci., 7 (3) : 59-63.

Food derived from animals (meat, eggs, milk, and dairy products) contain several important nutrients necessary for the growth and development of the brain and the rest of the body (Clark *et al.*, 2019). Food animal products must be preserved, transported, and handled in a safe manner at all stages of the food chain to protect the public health of the consumer from harmful agents and adulteration because they are perishable (Brink *et al.*, 2018). Unsafe preservation and displaying may transfer the pathogenic microorganisms to the food through the contact with hands, food-contact surfaces, equipment, and utensils. Abnormal changes in food due to unfollowing food safety practices are considered unsuitable for human especially if it is accompanied with changes in taste, color, or smell (WHO, 2002).

Food safety refers to handling, preparing, storing, and displaying food in a way to best reduce the risk of individuals becoming sick from foodborne illnesses. This includes several methods that must be followed to avoid exposure to any potential health

risks. Food can transmit many diseases from one person to another, in addition playing a role as a mediator for the growth of bacteria that cause food poisoning (Hughes *et al.*, 2007). Foodborne pathogens constitute a large proportion of food poisoning cases and admissions to hospitals, especially in hot climates (Godfray *et al.*, 2018). There are many pathogens contaminating foods of animal origin, for example *Salmonella* spp., *Campylobacter* spp., *Listeria monocytogenes*, pathogenic *E. coli*, *Clostridium perfringens*, Noroviruses, Rotaviruses, and *Toxoplasma gondii* associated with food poisoning (Adak *et al.*, 2007; Wolk, 2017).

The US Food and Drug Administration (FDA) has also published the Food Code, which is a standard set of guidelines and procedures that assist food control jurisdictions by providing a technical and scientifically legitimate basis for regulating food manufacturers and sellers, including restaurants, groceries and with the aim of developing and updating food safety rules in

each country to prevent foodborne diseases (FDA, 2010; Switaj *et al.*, 2015).

The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) have a strong interest in strengthening national food control systems that are based on scientific principles and guidelines and address all sectors of the food chain. This is of particular importance in developing countries that seek to improve food safety and quality (FAO, 2021). However, food safety system application in developing countries is weak due to the large number of legislations available in each country and weaknesses in monitoring and implementation of food safety practices during handling, storing, and displaying of food. Therefore we aimed to study methods of displaying food products (animal origin) such as red and white meat, eggs, and dairy products in the markets of Mosul city to assess the level of safety conditions in these markets.

MATERIALS AND METHODS

Target population

There was no specific database for the number and locations of markets that sell foods of animal origin in the city of Mosul. Therefore, we created a database for the study by dividing the city of Mosul into two parts: a left side and a right side. Then, the markets were selected and included in the study.

Audit instrument

A Market audit checklist was established for the study to include types of food products of animal origin {red or white meat (chicken), dairy products (yogurt, cheese, cream, etc.) and table eggs} to evaluate the method of displaying at room temperature (supposed to be 20-25 °C), refrigeration (supposed to be 4 °C), and freezing (supposed to be -18 °C) in the markets of Mosul city.

Sample design

For each side of Mosul city, five regions have markets were selected, then, ten markets were randomly selected. Convenience sampling was used in the selection of the five regions in Mosul city. The purpose of using convenience sampling (instead of random sampling) was to ensure that the selected sample is as equal as possible on the right and left sides in terms of the living level expenses.

The total number of markets that included in the study was 100 = 5 areas X 2 sides (right and left) X 10 markets for each region. As for the number of food products of animal origin that observed and audited, it was 400 (100 red meat, 100 chicken, 100 dairy products, 100 table eggs), four animal products are offered for sale in each market.

Audit administration

The data was collected from the markets in Mosul city during the period from 1/11/2021 to 15/1/2022, where we audited the markets that contain food products of animal origin that are ready for sale to customers. The method of displaying and preserving of the products inside the markets was visually observed, and then the results were recorded using the markets audit checklist.

Data analysis

Descriptive and inferential statistics were performed using JMP Pro16.1 software (2021 SAS Institute Inc., North Carolina, USA). The Chi-square test was used to determine whether there was a significant difference between the expected and the observed frequencies of market audit results on both sides of each method of animal product of displaying. The results were significant at $P < 0.05$.

RESULTS

Table (1) shows significant percentages of food products (animal origin) displayed in the markets of Mosul at room temperature. Out of 400 food products (animal origin) that have been audited, 151 are offered for sale at room temperature in the markets of Mosul city (right and left sides) and which constitute 37.8% of the total audited samples. While 32.8% of the audited food products were offered for sale at refrigerator temperature (refrigeration). As for freezing, it was limited to red and chicken meat only, as the percentage of these products was 29.4% of the total samples preserved in this way.

Table -1: Distribution of cattle by chiefdoms and towns in Koinadugu District, Sierra Leone:

Food products	Room temperature	Refrigeration	Freezing
Red meat	30%	39%	31%
Chicken meat	8%	5%	87%
Dairy products	24%	76%	
Table eggs	89%	11%	

As 89% of the table eggs displayed for sale in the markets of Mosul city (the areas of the right and left side) were at room temperature. The percentage of chicken meat stored and displayed in the markets in Mosul city was 87% by freezing method. There were no significant differences between the markets of the right and left side in terms of displaying methods of food products of animal origin ($P > 0.05$). Tables (2, 3, 4) show the number of food products (animal origin) displayed or preserved at room temperature, refrigeration and freezing in the markets of Mosul city (right and left sides).

Table 2: Number of food products of animal origin displayed at room temperature:

Food Products	Alarabi	Sumar	Methak	Alnoor	Alkaramah	Alfarouq	Babjaded	17 Tamooz	Mosul-jededa	Bab-sinjar
Red meat	1/10	2/10	3/10	4/10	4/10	2/10	5/10	4/10	3/10	2/10
Chicken meat	0/10	1/10	0/10	1/10	2/10	1/10	1/10	0/10	0/10	2/10
Dairy products	1/10	1/10	3/10	2/10	3/10	2/10	2/10	3/10	3/10	4/10
Table eggs	9/10	9/10	10/10	9/10	9/10	9/10	8/10	8/10	9/10	9/10

Left side regions: Alarabi, Sumar, Methak, Alnoor, Alkaramah.

Right side regions: Alfarouq, Babjaded, 17 Tamooz, Mosul-jededa, Bab-sinjar.

Table 3: Number of food products of animal origin displayed at refrigeration temperature:

Food Products	Alarabi	Sumar	Methak	Alnoor	Alkaramah	Alfarouq	Babjaded	17 Tamooz	Mosul-jededa	Bab-sinjar
Red meat	4/10	6/10	3/10	4/10	4/10	6/10	4/10	3/10	2/10	3/10
Chicken meat	0/10	1/10	0/10	2/10	0/10	1/10	0/10	0/10	1/10	0/10
Dairy products	9/10	9/10	7/10	8/10	7/10	8/10	8/10	7/10	7/10	6/10
Table eggs	1/10	1/10	0/10	1/10	1/10	1/10	2/10	2/10	1/10	1/10

Table 4: Number of food products of animal origin displayed at freezing temperature:

Food Products	Alarabi	Sumar	Methak	Alnoor	Alkaramah	Alfarouq	Babjaded	17 Tamooz	Mosul-jededa	Bab-sinjar
Red meat	5/10	2/10	4/10	2/10	2/10	2/10	1/10	3/10	5/10	5/10
Chicken meat	10/10	8/10	10/10	7/10	8/10	8/10	9/10	10/10	9/10	8/10

Left side regions: Alarabi, Sumar, Methak, Alnoor, Alkaramah

Right side regions: Alfarouq, Babjaded, 17 Tamooz, Mosul-jededa, Bab-sinjar

There were no significant differences between the markets of the right and left side in terms of displaying food products (animal origin) at room temperature, refrigeration or freezing. ($P > 0.05$).

DISCUSSION

Cooling and freezing of perishable food products contribute to preserving food and prolonging its quality. Refrigeration slows down the chemical and biological deterioration processes in foods. The storage period of fresh perishable foods such as meat, fish, eggs, and milk can be extended to several days by refrigeration, and several weeks or months by freezing (**Berry et al., 2008**). The study also showed that there was no significant difference between the markets of the two sides of the city of Mosul (right and left) in terms of using a good displaying method for food products, which indicates the food safety conditions are similar in all markets of Mosul city.

The results of the study showed a failure to follow food safety practices in term of displaying, preserving, and selling food products of animal origin in the markets of Mosul. Table eggs form the highest percentage (89%) as they were not displaying in the correct methods that recommended globally. Selling and displaying eggs at room temperature, even during winter season, cannot be relied upon it because the deterioration of eggs occurs faster at high temperatures compared to refrigerator temperatures of 4 °C (**Zeidler, 2002**). This problem is common in the city of Mosul, during the spring, summer, and autumn, where the most eggs in the market are not displayed at refrigerator, which may cause rapid deterioration of eggs and lowering nutritional value, in addition to egg rancidity and an undesirable smell. While only 11% of the audited eggs that offered for sale in the markets of Mosul city were kept at refrigerator, which preserves the quality of eggs.

On the other hand, 30% of the red meats (imported meat and ground meat) were offered for sale were at room temperature, and this considered a real hazard to the consumer through the spread of food poisoning and the spread of outbreaks that associated with pathogens that cause food poisoning (**Finger et al., 2019**). This percentage was not surprising to us because most of the fresh red meat offered in butcher shops without refrigeration or packaging. FAO and WHO have great interest in strengthening national food control systems that are based on scientific principles and guidelines, and that address all sectors of the food chain, primarily foods that animal origin. Where the temperature of the refrigerator must be at least 4 °C when storing meat, while the freezing temperature must be at least -18 °C for frozen meat because the reproduction of the most microorganisms transmitted through food decreases at a temperature of 4 °C, and the multiplication of bacteria stops at -18 °C (**FAO & WHO, 2019**).

Furthermore, the percentage of dairy products (yogurt, cheese, cream) offered at room temperature was 24%. Dairy products have short shelf life especially if it is not refrigerated and packaged. This study included auditing locally made dairy products in Mosul city markets only, meaning that packaged products such as imported cheese, packaged pasteurized milk and powdered milk were not included in the study. The high percentage of local dairy product that offered for sale without refrigeration considered a violation or ignoring of the food safety practices recommendation by the World Health Organization that keep dairy products at a refrigeration temperature 4 °C, which reduces the growth of bacteria and extends the shelf life of dairy products. Accurate temperature control of the environment and, preservation methods of foods are essential to produce high-quality dairy products (**Memisi et al., 2014**).

Lastly, 8% of the chicken meat was offered for sale in the markets of Mosul city at room temperature. Although this percentage is low, but it can cause public health concern because poultry products contain a lot of pathogens that cause food poisoning, such as *Salmonella* spp., *Campylobacter* spp., and *E. coli* (**Kagambèga et al., 2018**). Therefore, poultry products must be stored and displayed at 4°C or below which greatly reduces the growth rate of any pathogenic bacteria that may be present on the food (**Liang et al., 2021**). Refrigeration is required for all raw poultry products unless it is going directly from the slaughter line to heat treatment (**USDA-FSIS, 1998**). To prevent the rapid growth of pathogenic bacteria, poultry must be stored at refrigeration temperature (4°C) or frozen (-18°C) during transportation and in markets that offered for sale.

CONCLUSION

The finding of this study showed a failure to implement food safety practices in the markets of Mosul city that sell foods of animal origin. The applying of food safety practices in the markets of both sides of Mosul city (right and left) were similar in terms of displaying of food products (animal origin) where all markets have food products at room temperature. Also, this study showed weakness of health control through monitoring the applying of food safety practices in the markets in terms of the availability of refrigeration and freezing devices to display food products (animal origin). Therefore, it is recommended to not buying foods of animal origin displayed at room temperature. The findings help the government oversight to focus on the issues that exist in the markets of Mosul city.

ACKNOWLEDGMENTS:

We would like to thank all the markets that participated in this study, we appreciate their efforts.

Declaration of Conflicting Interests

The author of this manuscript stated there is no conflict of interest regarding the writing process or data analysis.

REFERENCES

- ADAK, G.K., LONG, S.M., and O'BRIEN, S.J., 2007. Foodborne transmission of infectious intestinal disease in England and Wales 1992–2003. *Food Control*, 18, pp.766–72. <https://doi.org/10.1016/j.foodcont.2006.01.009>.
- BERRY, M., FLETCHER, J., MCCIURE, P., and Wilkinson, J., 2008. Effects of freezing on nutritional and microbiological properties of foods. In: Judith A. E. (ed.), *Frozen food science and technology*, Blackwell Publishing Ltd., London, UK, pp. 26-50. <https://DOI:10.1002/9781444302325.ch2>
- BRINK, E., ROSSUM, C.V., POSTMA-SMEETS, A., STAFLEU, A., WOLVERS, D., and DOOREN, C.V. et al., 2018. Development of healthy and sustainable food-bade dietary guidelines for the Netherlands. *Public Health Nutrition*, 22(13), pp. 2419-2435. <https://doi.org/10.1017/S1368980019001435>.
- CLARK, M.A., SPRINGMANN, M., HILL, J., and TILMAN, D., 2019. Multiple health and environmental impacts of foods. *Proceedings of the National Academy of Sciences of the United States of America*, 116(46), pp. 23357–23362. <https://doi.org/10.1073/pnas.1906908116>
- FAO & WHO., 2019. *The State of Food Security and Nutrition in the World 2019: Safeguarding against economic slowdowns and downturns*. Rome: FAO.
- FINGER, J. A., BARONI, W. S. MAFFEI, D. F. BASTOS D. H., and PINTO, U. M., 2019. Overview of foodborne disease outbreaks in Brazil from 2000 to 2018. *Foods*, 8(10), pp. 434. <https://doi.org/10.3390/foods8100434>.
- FOOD and AGRICULTURE ORGANIZATION (FAO), 2021. *Guidelines Meat Inspection Principles based on risk and its application*. Available at: <https://www.fao.org/3/ca5465ar/ca5465ar.pdf>.
- FOOD and DRUG ADMINISTRATION (FDA), 2010. *International Posts: "Improving the Safety of Imported Food and Medical Products"*. Food and Drug Administration. Archived from the original on August 10, 2010. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK220404/>
- GODFRAY, H.C.J., AVEYARD, P., GARNETT, T., HALL, J.W., KEY, T.J., et al., 2018. Meat consumption, health, and the environment. *Science*, 361(6399). <https://doi.org/10.1126/science.aam5324>
- HUGHES, C., GILLESPIE, I.A., O'BRIEN, S.J., et al., 2007. Foodborne transmission of infectious intestinal disease in England and Wales, 1992–2003. *Food Control*, 18, pp.766–772. <https://doi:10.1016/j.foodcont.2006.01.009>
- JMP®, Pro 16.1., 2021. SAS Institute Inc., Cary, NC, 1989-2021.
- KAGAMBEGA, A, THIBODEAU, A., TRINETTA, V., et al., 2018. *Salmonella* spp. and *Campylobacter* spp. in poultry feces and carcasses in Ouagadougou, Burkina Faso. *Food Sci Nutr*. 6, pp.1601–1606. <https://doi.org/10.1002/fsn3.725>.
- LIANG, C., ZHANG, D., ZHENG, X., WEN, X., YAN, T., Zhang, Z., and HOU, C., 2021. Effects of different storage temperatures on the physicochemical properties and bacterial community structure of fresh lamb meat. *Food science of animal resources*, 41(3), pp.509–526. <https://doi.org/10.5851/kosfa.2021.e15>.
- MEMISI, N.R., MORACANIN, V., ŠKRINIAR, M.M., ILICICI, M., and AC, M.D., 2014. Storage temperature: A factor of shelf life of dairy products. *Acta Periodica Technologica*. 45. 55-66. <https://doi:10.2298/APT1445055M>.
- SWITAI, T., WINTER, K., and CHRISTENSEN, S., 2015. Diagnosis and Management of Foodborne Illness. *Am Fam Physician*. 192(5), pp.358-365. Available at: <https://www.aafp.org/pubs/afp/issues/2015/0901/p358.html>
- UNITED STATES DEPARTMENT OF AGRICULTURE-FOOD SAFETY and INSPECTION SERVICES (USDA-FSIS), 1998. *Safe storage of meat and poultry*. Washington, D.C. 20250-3700.
- WOLK, A., 2017. Potential health hazards of eating red meat. *Journal of Internal Medicine*, 281, pp. 106–122. <https://doi:10.1111/joim.12543>
- WORLD HEALTH ORGANISATION (WHO), 2002. *Fact Sheet No. 237 Revised January 2002. Food Safety and Foodborne Illness*. Available at: <http://www.who.int/mediacentre/factsheets/Fs237/en/>.
- ZEIDLER, G. 2002. Shell quality and preservation. In Bell, D. D. and Weaver, W. D. Jr. (eds). *Commercial Chicken Meat and Egg Production*. 5th rev. edn. Kluwer Academic Publishers, Norwell, pp. 1199-1217. https://doi.org/10.1007/978-1-4615-0811-3_60

How to cite this article:

Omar A. Al-Mahmood and Ali M. Najm, 2022. Investigating the Ways of Displaying Eggs, Dairy Products, and Meat in the Markets of Mosul City, Iraq. *Journal of Applied Veterinary Sciences*, 7 (3): 59– 63. DOI:<https://dx.doi.org/10.21608/javs.2022.135967.1146>