



Official Journal Issued by
Faculty of
Veterinary Medicine

Benha Veterinary Medical Journal

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



Since 1990

Original Paper

Sensory and bacteriological profiles of chicken meat under different thawing processes

El-Barody, S. A.¹, Khater, D. F.², Salem, A. M.¹

¹Department of Food Hygiene and Control, Faculty of Veterinary Medicine, Benha University, Egypt

²Department of Food Hygiene, Animal Health Research Institute, Tanta branch, Egypt

ARTICLE INFO

Keywords

Freezing
Thawing
APC
Enterobacteriaceae count
poultry meat

Received 24/10/2021

Accepted 08/11/2021

Available On-Line

01/01/2022

ABSTRACT

Freezing is an important accepted method of food preservation to keep the safety of meat products. The methodology used in freezing and thawing processes can affect on the quality of frozen foods. The aim of this study was to evaluate the sensory and microbial analysis of about 48 random samples of freshly slaughtered chicken breast and thigh meat (24 for each). Samples were collected from local commercial retail shops in Tanta city submitted to freezing (-18°C) for (1 week). Then, four different thawing methods were evaluated by using microwave oven for one minute, refrigeration at around 3 °C for 22 hrs., under tap water for 4hrs. and finally at room temperature for 4 hrs. The obtained results revealed that the best sensory character for breast and thigh meat samples thawed and rethawed in refrigerator were 8.6,8.6,7 and 8, respectively. Also, the best APC (log₁₀ cfu/g) in breast and thigh meat samples thawed and rethawed in microwave were 3.84±0.06, 00.00,4.78±0.43 and 2.01±1.7, respectively. As well as the best Enterobacteriaceae count was in breast and thigh meat samples thawed and rethawed in microwave were 0.00,0.00,0.00 and 1.86, respectively. Overall, using of the microwave thawing was faster than the traditional one and showed the less bacterial load, while thawing in refrigerator was showed the best sensory quality.

1. INTRODUCTION

Chicken meat contain high protein and low-fat content which consider an important component in healthy diets (Chumngoen and Tan, 2015). Freezing of meat has been practiced for several decades to prolong its shelf-life and maintain the quality during storage (Hananian and Mittal, 2004). Internal meat structure has affected by freezing and thawing rates through cellular disruption by ice crystal formation (Mandigo and Osburn1996). These extracellular ice crystals cause rupture of muscle cells and exudation of fluid. These exudates are called drip, which possess numerous important nutrients (Sen and Sharma, 2004). Moreover, foods are subject to damage by chemical and physical changes also the action of microorganisms during thawing. Therefore, optimum thawing procedures must be of concern to food technologists (Kalichevsky et al., 1995). Parameters like appearance, texture, flavor, color, nutritive value and microbial activity determine the shelf-life of meat affected by freezing and thawing cycles (Lampra et al., 2021). Sensory analysis had become important roles to evaluate quality. Factors which could adversely affect quality were organoleptic changes (Mulder, 1995). APC is of supreme importance in judging the hygienic condition of any food (Jay, 1997a). Enterobacteriaceae group has an epidemiological importance as some of its members are pathogenic and may cause food poisoning (Mercuri et al., 1978).

Different thawing methods, as at refrigerators, at room temperature in a microwave oven and under cold water may be used (He et al., 2013). Microwave irradiation has become more used in food processing to improve food quality and shelf life (Lin et al., 2014). Due to more food poisoning incidence the needed to more Studies about freezing temperature, freezing duration, thawing temperature could be done (Jongberg, et al.2014). Therefore, the present study has been undertaken to assess sensory and microbiological profiles of chicken meat under different thawing processes.

2. MATERIAL AND METHODS

2.1. Collection of samples (Oliveira et al., 2014):

Forty-eight random samples of freshly slaughtered chicken samples were collected from local commercial retail shops in Tanta city. The collected samples were preserved in separate plastic bags and transferred rapidly to the laboratory in an insulated ice box under complete aseptic conditions without any delay. Chicken samples divided to 2 groups, breast and thigh meat samples, then all samples were individually frozen at (-18°C) for (1 week) then. Four different thawing methods were applied by putting in microwave for one minute, in refrigerator at 3°C for 22 hrs, packed in low-density polyethylene bags and placed under tap water for 4hrs. and at room temperature for 4 hrs. After thawing, the different examination was applied. All samples refreezing and rethawing by the same methods and reexamined.

* Corresponding author: ahmed.eissa19855@gmail.com

2.2. Sensory analysis:

All tested samples were examined by an odd number of donor colleagues for physical characters as recommended by Kanatt et al. (2010).

2.3. Bacteriological analysis:

2.3.1. Preparation of samples (ISO, 6887-2:2017):

Under complete aseptic conditions, the examined samples were prepared. Twenty-five grams of breast and thigh meat samples were taken by scissors and forceps after sterilization and also surface sterilization by hot spatula, transferred to a sterile polyethylene bag, and 225 ml of 0.1% sterile buffered peptone water were aseptically added to content of the bag. Each sample was homogenized in a homogenizer (Warszawa homogenizer- model. MPW. 309 Mechanika precyzyjna- Boremlowsk 94 F6- 04- 347- Warszawa – Poland) at 2000 rpm for 1-2 minutes to make a homogenate of 1/10 dilution. One ml from the original dilution was applied with sterile pipette to another sterile test tube has 9 ml of sterile buffered peptone water 0.1% and mixed well to prepare the next dilution, from which further decimal serial dilutions were prepared.

The prepared samples were subjected to the following investigations:

2.3.2. Aerobic plate count was conducted on plate count agar according to (USDA,2011)

2.3.3. Psychrotrophic count was conducted on plate count agar according to (USDA, 2011)

2.3.4. Enterobacteriaceae count was conducted on Violet Red Bile Glucose according to (ISO,2001)

2.3.5. Pseudomonas count was conducted on Pseudomonas selective agar medium base (ISO,2004).

2.4. Statistical analysis:

Statistical data analysis for the three independent replicates was treated by one-way ANOVA using SPSS program according to (Ronser, 2002).

3. RESULTS

Table (1) illustrated the effects of varying thawing methods on sensory properties of breast and thigh meat samples and demonstrated better suitability in refrigerators method of thawing samples than for those thawed in microwave, at room temperature and under tap water. Breast and thigh meat samples thawed in refrigerator and in microwave were very very good, very very good, very good and very good, respectively. As well as breast and thigh meat samples after rethawed in refrigerator and in microwave were very good, very very good, good and good, respectively. While breast and thigh meat samples thawed and rethawed under tap water and at room temperature were good.

Table 1 The effect of various thawing processes on sensory profile of the examined chicken meat samples (n=48)

Method Thawing	In microwave		In refrigerators		Under tap water		At room temperature	
	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
Thawing	7.6±0.53 ^{ab}	7.6±0.57 ^{ab}	8.6±0.55 ^a	8.6±0.53 ^a	6.3±0.55 ^c	6.6±0.55 ^{bc}	6.6±0.57 ^{bc}	6.6±0.57 ^{bc}
Rethawing	6.3±0.53 ^c	6.3±0.00 ^c	7±0.00 ^{bc}	8.0±0.55 ^a	6.3±0.57 ^c	6.3±0.53 ^c	6.6±0.50 ^{bc}	6.3±0.50 ^c

The results achieved in Table (2) revealed that the Aerobic Plate Count (\log_{10} cfu/g) in the examined samples. Breast meat samples which thawed in microwave was 3.84 ± 0.06 while breast meat samples thawed in refrigerators, under tap water and at room temperature showed increase to 4.63 ± 0.30 , 6.25 ± 0.24 and 5.55 ± 0.49 , respectively. Moreover, the mean value of APC was lower in breast meat samples which rethawed in microwave 4.78 ± 0.43 than other methods were 5.25 ± 0.24 , 6.49 ± 0.19 and 6.23 ± 0.20 in refrigerators, under tap water and at room temperature. Also,

on thigh meat samples which thawed in microwave showed no microbial growth. While, samples thawed in refrigerators, under tap water and at room temperature were 4.97 ± 0.09 , 6.28 ± 0.19 and 6.04 ± 0.61 , respectively. Moreover, APC was gradually increased for all samples during rethawing with different ratio depending on method of thawing. Thigh meat samples which rethawed in microwave and in refrigerators were 2.01 ± 1.7 and 5.5 ± 0.59 , respectively. But under tap water and at room temperature were 6.92 ± 0.41 and 6.72 ± 0.87 , respectively.

Table 2 The effect of various thawing processes on APC (\log_{10} cfu/g) of the examined chicken meat samples (n=48)

Method Thawing	In microwave		In refrigerators		Under tap water		At room temperature	
	Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
Thawing	3.84 ± 0.06^d	0.00 ± 0.00^e	4.63 ± 0.30^c	4.97 ± 0.09^c	6.25 ± 0.24^a	6.28 ± 0.19^a	5.55 ± 0.49^b	6.04 ± 0.61^{ab}
Rethawing	4.78 ± 0.43^c	2.01 ± 1.7^d	5.25 ± 0.24^{bc}	5.50 ± 0.59^{abc}	6.49 ± 0.19^{ab}	6.92 ± 0.41^a	6.23 ± 0.20^{ab}	6.72 ± 0.87^a

Table (3) illustrated the psychrotrophic count (\log_{10} cfu/g) the mean value of breast samples which thawed in microwave was 1.66 ± 1.45 ; 2.57 ± 2.23 for breast meat

samples thawed in refrigerators; 2.44 ± 2.12 for breast meat samples thawed at room temperature; The other groups showed no microbial growth.

Table 3 The effect of various thawing processes on psychrotrophic count (log 10 cfu/g) of the examined chicken meat samples (n=48)

Method	Thawing	In microwave		In refrigerators		Under tap water		At room temperature	
		Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
Thawing		1.66±1.45 ^{ab}	0.00 ^b	2.57±2.23 ^a	0.00 ^b	0.00 ^b	0.00 ^b	2.44±2.12 ^a	0.00 ^b
Re-thawing		0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b	0.00 ^b

As shown in Table (4) the *Enterobacteriaceae* count (log₁₀ cfu/g) were gradually increased during thawing and rethawing. Breast and thigh meat samples thawed in microwave showed the best results as recorded no microbial growth compared with in refrigerators samples as recorded 1.66±1.45 for breast meat samples and 1.59±1.38 for thigh

meat samples. On other hand, breast and thigh meat samples which thawed and rethawed under tap water showed the highest value were 3.43±0.37, 3.78±0.43, 2.13±1.84 and 4.55±0.03, respectively. Table (5) showed no detection of pseudomonas in all examined samples.

Table 4 The effect of various thawing processes on Enterobacteriaceae count (log. Cfu/g) of the examined chicken meat samples (n=48)

Method	Thawing	In microwave		In refrigerators		Under tap water		At room temperature	
		Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
Thawing		0.00 ^b	0.00±0.00 ^b	1.66±1.45 ^{ab}	1.59±1.38 ^{ab}	3.43±0.37 ^a	2.13±1.84 ^{ab}	1.72±1.49 ^{ab}	1.99±1.73 ^{ab}
Rethawing		0.00±0.00 ^e	1.86±1.62 ^d	2.55±0.49 ^d	2.69±0.21 ^{cd}	3.78±0.43 ^{abc}	4.55±0.03 ^a	2.85±0.13 ^{bcd}	4.01±0.48 ^{ab}

Table 5 The Detection of pseudomonas from examined chicken meat samples thawed by various thawing processes (n=48)

Method	Thawing	In microwave		In refrigerators		Under tap water		At room temperature	
		Breast	Thigh	Breast	Thigh	Breast	Thigh	Breast	Thigh
Thawing		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rethawing		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

4. DISCUSSION

Sensory profile allows us to evaluate the quality of food and in some time identify unwanted contaminants (Rasooli, 2007). Odor, taste and appearance of a product can be the criteria for rejection of any kind of food if they differ significantly from what is expected by the consumers, (Chouliara et al., 2007). The results in Table (1) showed that sensory analysis of samples thawed in refrigerators showed the best sensory character, following in microwave while samples thawed at room temperature and under tap water showed the lowest character. Droval et al. (2012) reported that texture, appearance and flavor of the meat are the main quality attributes and the selection by consumers is commonly depended on the appearance of the meat. Although extremely dark or light colors in meat have been considered as a bad quality characteristic, different color among skinless breast fillets may be more important for the quality than the absolute color of the meat (Fletcher, 1999). Apostolou et al. (2005) cleared those marks from overheating are usually drawback of the microwave usage. These results agreed with Hakan (2016) who found that color values of chicken breast samples were 55.49±1.15 after defrosting by refrigerators. Chicken meat loss flavor and juiciness and become dry in texture during frozen storage (Ayeshe et al., 1997).

The results achieved in Table (2) revealed that the Aerobic Plate Count (log₁₀ cfu/g) in the examined samples. The samples thawed at room temperature and under tap water showed the highest APC (log₁₀ cfu/g) comparing to that thawed in microwave and in refrigerators. APC was gradually increased during rethawing for all samples with different ratios depending on the type of thawing methods,

while samples thawed in microwave still the lowest count. Moreover, APC was gradually increased for all samples during rethawing with different ratio depending on method of thawing.

The current results were nearly similar to the results recorded by (Boubaker et al., 2013) founded that total mesophilic flora in samples thawed in microwave was 2±0.5 while in refrigerator 3±0.5. The persistence of some bacteria after exposure to microwave may be due to thermal destructive point within the samples was not reached as the temperature monitored did not exceed 4 °C. Table (3) illustrated the mean value of psychrotrophic count (log₁₀ cfu/g) breast samples which thawed in microwave. It was 1.66±1.45; 2.57±2.23 for breast samples thawed in refrigerators; 2.44±2.12 for breast samples thawed at room temperature; The other groups showed no growth. Hedrick et al. (1994) found that the decreased in psychrotrophic count from samples stored at freezing because the death of these bacteria in meat by thermal shock, ice formation, dehydration and high solute concentration.

As shown in Table (4) the Enterobacteriaceae count (log₁₀ cfu/g) were gradually increased during thawing and rethawing. Breast and thigh samples thawed in microwave showed the best results as recorded no growth. This result came in agreement with (Serap et al., 2008) as concluded that the microwave produced lethal effect on *E. coli* by heat generated during microwave exposure. As well as it agreed with (Farag et al., 2000) who founded total coliform count in liver samples 3. 3×10³ while in liver samples defrost in microwave recorded no growth. Palaniappan et al. (1990) recorded the inactivation effect due to heating of the radiations. Also explained deadly cellular and genetic injuries after exposure to microwave (Nasri et al., 2013). Wu

and Yaho (2011) reported that microwave interference with critical cell compounds, RNA, DNA and cell membrane. Table (5) showed no detection of pseudomonas in examined samples. This result was nearly similar to that obtained by Samia (2004) which recorded no growth to psychrotrophic bacteria and pseudomonas one member of psychrotrophic bacteria.

5. CONCLUSION

The microwave thawing process showed the less APC and *Enterobacteriaceae* count. Pseudomonas was not detected. While refrigerators method showed the best sensory characters.

6. REFERENCES

1. Apostolo, I., Papadopoulou, C., Levidiotou, S., Ioannides, K. 2005. The effect of short-time microwave exposures on *Escherichia coli* O157:H7 inoculated onto chicken meat portions and whole chickens. *International Journal Food Microbiology* 101,105-110.
2. Ayyesh, A.M., Nadir, A.S and Ibrahim, A.M. 1997. Effect of frozen storage on the content of biogenic amines edible parts of chicken. *Egypt Journal Food Science* 25(1),83-97.
3. Boubaker, K., Mosbah, A. and Jaafar, M. 2014. Microbiological comparison of microwave and traditional thawing processes for poultry meat. *African Journal of microbiology research* 8(1),109-117.
4. Chouliara, E., Karatapanis, A., Savvaidis, I.N. and Kontominas, M.G. 2007. Combined effect of oregano essential oil and modified atmosphere packaging on shelf-life extension of fresh chicken breast meat stored at 4-degree C. *Food Microbiology* 24,607-617 .
5. Chumngoen, W., Tan, F.J. 2015. Relationships between descriptive sensory attributes and physicochemical analysis of broiler and Taiwan native chicken breast meat. *Asian- Australas Journal Animal Science* 28,1028-37.
6. Droval, A. A., V. T., Benassi, A., Rossa, S. H., Prudencio, F. G., Paiao, and Shimokomaki, M. 2012. Consumer attitudes and preferences regarding pale, soft, and exudative broiler breast meat. *Journal Applied Poultry Research* 21,502-507.
7. Farag, R.S., Daw, Z.Y., Farag, S.A. and Safaa, A.E. Abd El-Wahab. 2000. Bio-9 A comparison of gamma irradiation and microwave treatments on the lipids and microbiological pattern of beef liver. Seventh Conference of nuclear science and applications 6-10 February 2000 Cairo, Egypt.
8. Fletcher, D. L. 1999. Colour variation in commercially packaged broiler breast fillets. *Journal Applied Poultry Research* 8,67-69.
9. Hakan, B. 2016. Consumer attitudes toward storing and thawing chicken and effects of the common thawing practices on some quality characteristics of frozen chicken. *Asian Australas. Journal Animal Science* 29(1),100-108.
10. Hanenian, R. and Mittal, G. S. 2004. Effect of freezing and thawing on meat quality. *Journal of Food Agriculture and Environment* 2(3 and 4), 74-80.
11. Hedrick, H.B., Aberle, E.D., Forrest Judge, M.D. and Merkel, R.A. 1994. Storage and preservation of meat "3rd, Kendall Hunt Publishing Co., Dubuque, LA.
12. He, x., Tatsumi, E., Nirasawa, S., Liu, H. 2014. Factors affecting the thawing characteristics and energy consumption of frozen pork tenderloin meat using high-voltage electrostatic field. *Innovative Food Science and Emerging Technology* 22,110-115 .
13. ISO 21528-3 2001. International Organization for Standardization Microbiology of Food and Animal Feeding Stuffs-Horizontal method storage stability of beef meat. *Meat Science* 77,616-25.
14. ISO International Organization for standardization" 2004. No.11291- 1. Microbiology of food and animal feeding Stuffs-Horizontal methods for the detection and enumeration of Enterobacteriaceae
15. ISO 6887-2-2017. Microbiology of food and animal feeding stuffs-preparation of test samples, initial suspension and decimal dilution for microbiological examination-part 2: Specific rules for the preparation of meat and meat products, Switzerland, Vienna .
16. Jay, J.M. 1997. Modern food microbiology. 4th Ed. Chapman and Hall, International Thomson Publishing, New York, John .
17. Jongberg, S., Wen, J., Tørngren, M. A. and Lund, M.N. 2014. Effect of high- oxygen atmosphere packaging on oxidative stability and sensory quality of two chicken muscles during chill storage. *Food Package. Shelf Life* 1,38-48.
18. Kalichevsky, M.T., Knorr, D., Lillford, P.J. 1995. Potential food applications of high-pressure effects on ice- water transitions. *Trends Food Science Technology* 6,253-58.
19. Kanatt, S. R., Chnder, R. and Sharma, A. 2010. Antioxidant and activity of pomegranate peel extract improves the shelf life of chicken products. *International Journal of Food Science Technology* 2 (45), 216-222.
20. Lampra, D. V., Chandirasekaran, A., Irshad, S. S. and Gopala, K. M., T. R. 2021. Effects of Different Thawing Methods on the pH, Water Holding Capacity, Extract Release Volume and TBA value of Broiler Chicken under Repeated Freeze-thaw Cycles. *International Journal Current. Microbiology Applied Science* 10(03), 141-149.
21. Lin, Y.C., Hsu, K.H, Lin, J.F. 2014. Rapid palm-biodiesel production assisted by a microwave system and sodium methoxide catalyst. *Fuel.* 115,306- 311.
22. Mandigo, R.W., Osburn, W.N. 1996. Cured and processed meats. In: Jeremiah LE, editor. Freezing effects on food quality. New York: Marcel Dekker, 135-82 .
23. Mercuri, A.J., Cox, N.A., Carson, M.O. and Tanner, D.A. 1978. Relation of Enterobacteriaceae count to Salmonella contamination of Marker Broiler. *Journal Food protection.* 42,427.
24. Mulder, R. 1995. Quality of poultry products and consumer production archive Fur.G eflugeik Under No. Sondeheft, 55-57.
25. Nasri., K., Daghfous, D., Landoulsi, A. 2013. Effects of (microwave)2.45 GHz irradiation on some biological characters of *Salmonella typhimurium*. *C.R. Biologies.* 336,197-202.
26. Oliverira, M.R., Gubert, G., Roman, S.S., Kempka, A.P. and Prestes, R.C. 2014. Meat quality of chicken breast subjected to different thawing methods. *Brazilian Journal of Poultry Science.* 17(2),165-172 .

27. Palaniappan, S., Sastry, S.K., Richter, E.R.1990. Effects of electricity on microorganisms. *Journal Food Process Preservation*. 14,393-414.
28. Rasooli, I. 2007. Food preservation, a bio preservation approach, food (Ed) Global Science book, 1, 111-136
29. Rosner, B. 2002. *Fundamental of Biostatistics*. 4th Ed. (ed. P. W. Kent), Publishing Co. California, USA.
30. Samia, E. F.2004. Chemical and oranoleptical study on some frozen foods during handling and processing. Ph.D. Thesis Faculty of Agriculture. Al – Azhar. Egypt.
31. Sen, A. R. and N. Sharma, 2004. Effect of freezing and thawing on the histology and ultrastructure of buffalo muscle. *Asian- Australas. Journal Animal Science*. 17(9),1291-1295
32. Serap, G, Ozge, T., Ozlem,T. and Ahmet, C. 2008. Effect of microwaves on some Gram negative and Gram positive bacteria. *Journal of applied biological science* 2(1),67-71.
33. USDA .2011. *Quantitative Analysis of Bacteria in Foods as Sanitary Indicators* January 2011.
34. Wu, Y., Yao, M. 2011. Effects of microwave irradiation on concentration diversity and gene mutation of culturable airborne microorganisms of inhalable sizes in different environments. *Journal Aerosol Science* 42,800-810.