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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(9): 2187-2190
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www.thepharmajournal.com
Received: 09-07-2022
Accepted: 12-08-2022

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Impact of sous vide cooking and pressure cooking on micronutrients of chicken meat

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Abstract
A study was carried out to evaluate the impact of sous vide cooking and pressure cooking on the micronutrients of broiler chicken meat. Broiler chicken breast meat was subjected to sous vide cooking and pressure cooking. Fresh and cooked meat samples were evaluated for vitamins (Thiamin, Riboflavin, Niacin and Cyanocobalamin) and minerals (Calcium, Phosphorus, Iron, Zinc and Copper). Results of the study revealed there was a highly significant difference ($p<0.01$) in the vitamin retention rate of sous vide cooking compared to pressure cooking. Vitamin contents decreased during cooking, with thiamine showing the highest losses. However, sous vide cooking had a higher value. The calcium, phosphorus, iron, zinc and copper content increased during cooking processes. In conclusion, the cooking methods considerably affected the nutrient contents to different degrees, which should be taken into account when the nutrient intake of meat is projected.

Keywords: Sous vide cooking, pressure cooking, chicken meat, vitamins, minerals

Introduction
Meat is considered an integral component of the human diet, which is a rich source of valuable protein, vitamins, minerals, micronutrients and fats. Meat supplies omega 3-fatty acid and conjugated linoleic acid, which provide valuable nutrients (Devi *et al*., 2014) [1]. Zargar *et al*. (2014) [2] mentioned that the rising costs of chevon and mutton coupled with the requirement to develop convenient meat items have created a need for alternatives. Meat consumption in India is increasing and poultry meat is the most preferential meat due to its affordability and without any religious taboos. Chicken meat has a high nutritive value, good taste and aroma, and soft texture and is relatively cheaper in price (Suriani *et al*., 2014) [3]. Biological value and net protein utility are significantly higher in commercial broiler meat (Sathishkumar, 2019) [4]. Cooking is an integral part of the processing and preparation of meat products and has a significant effect on the quality and sensory characteristics, such as the texture and flavour of the finished products (Gomez et al. 2020) [5]. However, severe heat treatment leads to undesirable changes, such as reduction of nutritional value and bioavailability mainly due to destruction of amino acids, peptides, vitamins, inferior sensory quality, development of warmed-over flavour (WOF), protein oxidation and reduction in the shelf-life (Morrissey *et al.*, 1998) [6]. Gerber *et al.* (2009) [7]. Mentioned that all vitamins decreased during cooking, with thiamine showing the highest losses, from 73% up to 100%. Moreover, the micronutrient content of cooked meat available in food composition databases is quite limited.

Materials and Methods
The broilers breast used in this study were obtained from the local markets. Their live weight ranged between (1900–2100 g) and the average age 8 weeks. Chicken breast was cut into 20- to 25-mm-thick meat and cooked by Sous vide and pressure cooking. Sous vide cooked in a thermostatized water bath at 80 °C for 30 minutes, a heating treatment was completed when samples reached an internal temperature of 75 °C, which was monitored during cooking using a digital probe thermometer (Testo thermocouple, Mod. 735-1, Lenzkirch, Germany). Pressure-cooking chicken breast was placed in a pressure cooker and cooked for 10 minutes (reaching 121 °C without holding time). After cooking and cooling, samples were vacuum-packed and stored at 20 °C until laboratory analysis was carried out.

Mineral content

The mineral content of raw and cooked chicken meat samples as determined as per the methods recommended by AOAC (2016) [8]. Calcium was estimated by the permanganimetric titration method. Phosphorus and copper were estimated by the spectrophotometric method using wavelength of 660 nm and 440 nm. Iron was estimated by the pyridine method using wavelength of 519 nm. Zinc and copper were estimated by Atomic Absorption Spectrometry.

Vitamin content

The vitamin content of raw and cooked chicken meat samples was determined as per the methods recommended by AOAC (2019) [9]. Thiamine, riboflavin and niacin were separated and quantified by HPLC after acidic and enzymatic (Takadiastase) hydrolysis of the samples, following the procedure described by Barna and Dworschak (1994) [10]. Vitamin B12 content was measured by Mun *et al.* (2017) [11]. Analyses of vitamins were performed by HPLC, detector operating at 200 nm to 600 nm. Chromatographic separation was achieved on a C18 column (250 cm x 5 µm) (Simmetry Waters). The mobile phase was phosphate buffer: methanol (gradient). Flow rate: 1 mL/min. Identification of the peaks of interest was performed by comparison with retention times of external standards. Analyses were performed in triplicate.

Results and Discussion

Vitamin content

The mean ± S.E of Vitamin content (Thiamin, Riboflavin, Niacin and Cyanocobalamin) of fresh and cooked meat were presented in Table 1. There was a highly significant difference (p<0.01) in thiamin, riboflavin, niacin and Cyanocobalamin content of fresh and cooked chicken. Further, a decreasing trend in vitamin content was noticed as a result of cooking process. The sous vide cooked chicken meat had higher thiamin, riboflavin, niacin and Cyanocobalamin content compared to pressure cooked meat.

Table 1: Impact of cooking methods on vitamin content of broiler chicken breast meat

Vitamin	Control	Sous vide cooking	Pressure Cooking
Thiamin(mg/100 g)	0.073±0.01^c	0.059±0.10^b	0.048±0.00^a
Riboflavin(mg/100 g)	0.092±0.01^c	0.089±0.01^b	0.070±0.02^a
Niacin (mg/100 g)	7.233±0.021^c	6.433±0.021^b	5.833±0.02^a
Cobalamine Vitamin B12 (µg/100 g)	1.233±0.007^c	0.967±0.006^b	0.823±0.00^a

Mean ± SE with at least one common superscript within classes do not differ significantly (p>0.05). n =6 for each treatment.

The reduction of thiamin content of cooked meat in the current study results are in agreement with the results of Yang *et al*. (1994) [12]. Reported that when beef strips were cooked by three methods to the same internal temperature of 71°C (160°F), the mean thiamin yields were 70.2% for stir-frying, 63.9% for microwaving, and 61.8% for broiling. A true retention value of thiamin was significantly higher in strips cooked by stir-frying than in those cooked by microwaving or broiling. Polidori *et al.* (2021) [13]. Reported that the cooking procedure decreased B vitamin complex content, mainly thiamin by thermal degradation, becoming hard to detect in the cooked meat analyzed. The reduction of riboflavin content of cooked meat in the current study results are in agreement with the results of Gerber *et al*. (2009) [7]. Reported that riboflavin losses in grilling, boiling and braising were 48.60 to 53.40, 83.40 and 67.60 per cent, respectively. Lombradi-Boccia *et al*. (2005) [14]. reported that riboflavin content in the raw and pan-cooked chicken breast were 0.03 and 0.01, respectively. However, Polidori *et al.* (2021) [13] reported the riboflavin content of raw and cooked (Cooked in an oven at 170 °C for 45 min) donkey meat as 0.22 ± 0.07 and 0.18 ± 0.05, respectively.

The reduction of niacin content of cooked meat in the current study results are in agreement with the results of Gerber *et al*. (2009) [7] reported that niacin losses in grilling, boiling and braising were 39.5 to 53.4, 65.2 and 64.0 per cent, respectively. Lombradi-Boccia *et al*. (2005) [14] reported that niacin content in the raw and pan-cooked chicken breast were 0.03 and 0.01, respectively. Karimian-Khosroshahi *et al*. (2016) [15] reported the niacin content of raw and cooked rainbow trout was control- 6.21, baked 5.36, boiled- 4.48, microwaved -5.37, and fried- 5.41 mg/100 g. They observed that boiling reduced niacin content significantly (p<0.05). Polidori et al. (2021) [13] reported the niacin content of raw and cooked donkey meat as 6.09 ± 0.27 and 5.22 ± 0.16, respectively. The cyanocobalamin content of the current study results is in agreement with the report of Bennink and Ono (1982) [16], who reported that vitamin B-12 content of raw and cooked separable lean ranged from 1 – 10 µg/100 g, with a mean value of 3.17 µg B-12/100 g. Czerwonka *et al*. (2014) [17] observed that **r**oasting and grilling had little effect on vitamin B12, while frying reduced the content of this vitamin by 32 per cent compared with that in raw meat. However, Polidori *et al.* (2021) [13] reported that the cyanocobalamin content of raw and cooked donkey meat were 1.80 ± 0.15 and 1.10 ± 0.04, respectively. Moreover, these results are in agreement with the current study results

Mineral content

The mean ± S.E of mineral content **(**Calcium, Phosphorus, Iron, Zinc and Copper) of fresh and cooked meat were presented in Table 1. There was a highly significant difference (p<0.01) in calcium, phosphorus, iron, zinc and copper content of fresh and cooked chicken. Further, a increasing trend in mineral content was noticed as a result of cooking process. This may be due cooking loss of meat during heat treatment. The sous vide cooked chicken meat had higher calcium, phosphorus, iron, zinc and copper content compared to pressure cooked meat.

Table 2: Impact of cooking methods on mineral content of broiler chicken breast meat

Method of Cooking	Control (Raw meat)	Sous vide cooking	Pressure cooking
Calcium (percent)	0.10±0.01^a	0.11±0.01^a	0.19±0.02^b
Phosphorus (percent)	0.20±0.00^a	0.21±0.02^{ab}	0.23±0.00^b
Iron (ppm)	161.67±0.56^a	193.63±3.17^b	224.07±0.1^c
Zinc (Mg/Kg)	2.90±0.01^a	3.08±0.00^b	3.10±0.04^b
Copper (Ppm)	5.93±0.01^a	7.85±0.01^b	9.58±0.03^c

Mean ± SE with at least one common superscript within classes do not differ significantly (p>0.05). n =6 for each treatment

The calcium content of the current study results are in agreement with the report of Purchas *et al.* (2014) [18] compared the mineral content in uncooked and cooked lean beef and reported increased calcium in cooked meat compared with the levels found in raw meat. Kim *et al.* (2015) [19] did blanching of beef by immersion in boiling water (1-10 min), steaming (1-10 min), or pan-frying in oil (30-240 s) and observed that calcium content was high in the pan-fried samples, but the boiled and steamed samples had the same content. In contrast to this study results, grilling and boiling pork and beef decreased the contents of calcium content in cooked meat (Gerber *et al.*, 2009) [7] in comparison of raw meat. The phosphorus content of the current study results are in agreement with the report of Tomovic *et al.* (2015) [20] studied the effects of endpoint temperatures of 51, 61, 71, 81 and 91 °C on mineral contents of pork loin were studied and all cooking treatments led to significantly increased mineral contents. As endpoint temperature increased, mineral contents increased, reaching numerically or significantly highest contents at 71 °C for phosphorus, after which mineral contents decreased in pork loin. In contrast to this study, grilling and boiling pork and beef decreased the contents of phosphorus content in cooked meat (Gerber *et al.*, 2009) [7] compared to raw meat.

The iron content of the current study results are in agreement with Gerber *et al.* (2009) [7] who reported that iron content increased in grilled, boiled, pan-fried and then steamed meat samples. Purchas *et al.* (2014) [18] compared the mineral content in uncooked and cooked lean beef and noticed as increased iron in cooked meat. Kim *et al.* (2015) [19] reported that the highest iron content was observed in boiled beef samples, followed by pan-fried samples. The zinc content of the current results are in congruence with the report of Gerber *et al.* (2009) [7] who reported a significant increase of zinc due to cooking of beef cut. Purchas *et al.* (2014) [18] compared the mineral content in uncooked and cooked lean beef and noted increased zinc in cooked meat compared with the levels found in raw meat. Some authors have indicated that minerals are very stable during cooking, whereas others have reported a higher mineral concentration after cooking because of increased dry matter (Campo *et al.*, 2013) [21].

The copper content of the study results are in agreement with Purchas *et al.* (2014) [18] who reported increased copper in cooked meat compared with the levels found in raw meat. Uran and Gokoglu (2014) [22] reported that the lowest concentration of copper was found in fried samples; and the highest ones in grilled samples. Additionally, the retention of minerals content in sous vide cooking (Falowo *et al.*, 2017; Silava *et al.*, 2016) [23, 24] was similar to raw meat and higher than boiled samples.

Conclusion

The micronutrient contents of broiler chicken breast meat were affected by sous vide and pressure cooking methods. To determine how much of the respective nutrients were gained or lost, it is important to compare the contents in absolute terms based on an initial weight of raw meat to take into account the directed effect caused by water loss during cooking. Cooking processes seemed to influence the various minerals at different rates. Based on the current study results, it is revealed that sous vide cooking retained higher vitamin concentrations of thiamin, riboflavin, niacin and cyanocobalamin compared to pressure cooking of broiler chicken breast meat.

Reference

1. Devi SM, Balachandar V, Lee S, Kim IH. An outline of meat consumption in the Indian population - A Pilot Review. Korean Journal of Food Science of Animal Resources. 2014;34:507-515.
2. Zargar FA, Kumar S, Bhat ZF, Kumar P. Effect of pumpkin on the quality characteristics and storage quality of aerobically packaged chicken sausages. Springer Plus. 2014;3:1-10.
3. Suriani NW, Purnomo H, Estiasih T, Suwetja IK. Physicochemical properties, fatty acids profile and cholesterol content of indigenous Manado chicken, broiler and spent hen meat. International Journal of Chem Tech Research. 2014;6:3896-3902.
4. Sathishkumar R. Comparison of meat quality and nutrient composition of commercial native chicken, backyard native chicken, commercial broiler and spent layer chicken. M.V.Sc thesis submitted to Tamil Nadu Veterinary and Animal Sciences University Chennai; 2019. p. 51.
5. Gómez I, Janardhanan R, Ibañez FC, Beriain MJ. The Effects of Processing and Preservation Technologies on Meat Quality: Sensory and Nutritional Aspects. Food. 2020;9:1416.
6. Morrissey PA, Sheehy PJA, Galvin K, Kerry JP, Buckley DJ. Lipid stability in meat and meat products, Meat Science. 1998;49:73-86.
7. Gerber N, Scheeder MR, Wenk C. The influence of cooking and fat trimming on the actual nutrient intake from meat. Meat Science. 2009;81:48-54.
8. AOAC. Official methods of analysis. 20th edition, 3rd revised, Association of Official Analytical Chemists. Washington, DC; 2016, 1.
9. AOAC. Official methods of analysis. 21th edition, Association of Official Analytical Chemists. Washington, DC; 2019.
10. Barna E, Dworschak E. Determination of thiamine (vitamin B1) and riboflavin (vitamin B2) in meat and liver by high-performance liquid chromatography. Journal of Chromatography. 1994;668:359-363.
11. Mun G, Song W, Park S, Jeong B, Jung G, Choi K, *et al*. Analysis of Vitamin B12 in fresh cuts of Korean pork for update of national standard food composition table. Korean Journal of Food Preservation. 2017;24:983-991.
12. Yang J, Sulaeman A, Setiawan B, Atughonu A, Giraud DW, Driskell JA. Sensory qualities and nutrient retention of beef strips prepared by different household cooking techniques. Journal of the American Dietetic Association. 1994;94:2-5.
13. Polidori P, Girolami PD, Vincenzetti S. Vitamins and minerals in raw and cooked donkey meat; 2021. https://www.intechopen.com/chapters/75724.
14. Lombardi-Boccia G, Lanzi S, Aguzzi A. Aspects of meat quality: trace elements and B vitamins in raw and cooked meats. Journal of Food Composition and Analysis. 2005;18:39-46.
15. Karimian-Khosroshahi N, Hosseini H, Rezaei M, Khaksar R, Mahmoudzadeh M. Effect of Different Cooking Methods on Minerals, Vitamins, and Nutritional Quality Indices of Rainbow Trout (*Oncorhynchus mykiss*). International Journal of Food Properties. 2016;19:2471-2480,
16. Bennink M, Ono K. Vitamin B12, E and D Content of Raw and Cooked Beef. Journal of Food Science. 2006;47:1786-1792.
17. Czerwonka M, Szterk A, Waszkiewicz-Robak B. Vitamin B12 content in raw and cooked beef. Meat Science. 2014;96:1371-1375.
18. Purchas R, Wilkinson B, Carruthers F, Jackson F. A comparison of the nutrient content of uncooked and cooked lean from New Zealand beef and lamb. Journal of

Food Composition and Analysis. 2014;35:75-82.
19. Kim KI, Lee SY, Hwang IG, Yoo SM, Min SG, Choi MJ. Quality Characteristics of Beef by Different Cooking Methods for Frozen Home Meal Replacements. Korean Journal of Food Science of Animal Resources. 2015;35:441-448.
20. Tomovic V, Jokanovic M, Sojic B, Snezana S, Tasic T, Ikonic P. Minerals in Pork Meat and Edible Offal. Procedia Food Science. 2015;5:293-295.
21. Campo M, Muela E, Olleta JL, Moreno LA, Santaliestra-Pasias AM, Mesana ML, *et al.* Influence of cooking method on the nutrient composition of Spanish light lamb. Journal of Food Composition and Analysis. 2013;31:185-190.
22. Uran H, Gokoglu N. Effects of cooking methods and temperatures on nutritional and quality characteristics of anchovy (*Engraulis encrasicholus*). Journal of Food Science and Technology. 2014;51:722-728.
23. Fellows P. Processing Technology Principles and Practice. 2nd Edition, Woodhead Publishing Limited and CRC Press LLC, Washington DC; 2000. p. 98.
24. Silva FAP, Ferreira VC, Madruga MS, Estevez. Effect of the cooking method (grilling, roasting, frying and sous-vide) on the oxidation of thiols, tryptophan, alkaline amino acids and protein cross-linking in jerky chicken. Journal of Food Science and Technology. 2016:53:3137–3146.