PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

OPEN ACCESS Pakistan Journal of Nutrition

ISSN 1680-5194
DOI: 10.3923/pjn.2017.412.416

Research Article
Comparative Analysis of Red and White Turkey Meat Quality

Kumarbek Amirkhanov, Aidyn Igenbayev, Almagul Nurgazezova, Eleonora Okuskhanova, Samat Kassymov, Nazerke Muslimova and Zhanibek Yessimbekov

Department of Technology of Food and Light Industry Products, Shakarim State University of Semey, 071412 Semey, Kazakhstan

Abstract

Objective: The purpose of the current study was to evaluate red and white turkey meat quality in Kazakhstan by analyzing its chemical, amino acid and vitamin composition. **Materials and Methods:** Red and white meat was assessed from 3-4 months-old (start of the fattening period) and 6-12 months-old (end of the fattening period) turkeys (N = 10 turkeys each). Amino acid and vitamin composition was quantified with a Shimadzu LC-20 Prominence liquid chromatography system. **Results:** White turkey meat was found to contain 11.4-12.0% fat, while red meat contained 20.3-21.7% fat. The protein content in white meat varied between 21.4-21.7% and 18.8-19.5% in red meat. Moreover, the amino acid composition of white turkey meat was richer in essential amino acids than the red Turkey meat. After the fattening period, a slight decrease in protein (-0.7%) and increase in fat (1.4%) content was observed in both red and white turkey meat. **Conclusion:** The fattening period is beneficial for enriching the level of essential amino acids in white and red turkey meats.

Key words: Turkey meat, essential amino acids, vitamin, white and red meat, chemical composition

Received: January 05, 2017 Accepted: April 15, 2017 Published: May 15, 2017

Citation: Kumarbek Amirkhanov, Aidyn Igenbayev, Almagul Nurgazezova, Eleonora Okuskhanova, Samat Kassymov, Nazerke Muslimova and Zhanibek Yessimbekov, 2017. Comparative analysis of red and white turkey meat quality. Pak. J. Nutr., 16: 412-416.

Corresponding Author: Zhanibek Yessimbekov, Department of Technology of Food and Light Industry Products, Shakarim State University of Semey, 20 A Glinki Street, 071412 Semey, Kazakhstan Tel: +77475205267

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Healthy and adequate nutrition is the most important factor of population health. In the poultry industry of the Republic of Kazakhstan, there is a wide range of poultry meat products; however, very few broad turkey meat processing products are on the market[1]. Poultry meat differs from cattle meat in its high content of complete proteins (poultry, 19.5%; beef, 13.0%) and poultry fat has a lower melting point (36.5°C) that makes the meat easier to digest by humans. Moreover, the chemical composition of poultry meat differs according to the age and breed[2]. The biological value of poultry protein is defined by its content of essential amino acids. The quality composition of amino acids of poultry was described by Sokolov *et al.*[3] and Essary and Ritchey[4]. Poultry meat is characterized by an optimum quantitative ratio of essential amino acids, being slightly richer in lysine and arginine than beef[5].

Breeding of turkeys is important for increasing the production of high-quality poultry meat. The production of turkey meat is gaining popularity among food industries of Kazakhstan. The current leader in turkey meat processing in Kazakhstan has a production capacity of 8110 t $year^{-1}$ and is projected to increase capacity to 25,000 t in 2017. The main difference between turkey and other poultry is its large size, high breeding performance and yield of edible parts; turkeys surpass other birds in live mass. Turkey meat is very rich in protein compared to that of geese and is not as fatty, which is very important for people with high levels of cholesterol[6]. Turkey meat also contains B- and PP-group vitamins, phosphorus and minerals necessary for the normal function of many organs of the human body[7,8]. Furthermore, turkey meat is a low allergy food, making it ideal for baby food[9]. Hence, turkey meat is an excellent source of animal protein.

The nutritional and biological value of turkey meat is defined by it's essential amino acid content and ratio, as well as its digestibility[10]. Its proper breeding gives it high nutritive, taste and culinary qualities. Domestic turkeys are bigger and heavier in weight than wild turkeys, with the weight of domestic adult males and hens reaching 20-30 kg and 7-10 kg, respectively. The live weight of hens up to 4 months of age typically exceeds 6 kg, while that of 5-6 months-old males is 12-14 kg. Compared to other poultry, turkeys have the highest edible live weight (>70% edible), consisting of $\geq$60% muscular tissue and $\leq$28% pectoral muscle. It contains a large amount of protein (28% versus 14–18% in other poultry meats), moderate amount of fat (2–5%), rich in B vitamins and has a lower level of cholesterol than other types of meat[11,12]. The purpose of the present study was to evaluate and compare the quality of red and white turkey meat in Kazakhstan by analyzing their chemical, amino acid and vitamin composition.

MATERIALS AND METHODS

Sampling: Turkey meat carcasses were obtained from a local farm and food markets in East Kazakhstan and sorted into two age groups: 3-4 and 6-12-months-old turkeys. The average mass of carcass meat for 3-4-months turkeys was 4.2 kg and 7.5 kg for 6-12-months-old turkeys; in total, 20 kg of meat was sampled. The turkey meat was transported to laboratory of Shakarim State University in a special refrigerator and stored at -2 to -4°C before the analysis. Then, the carcasses were cut up and the meat sorted into red (ham) and white (breast).

Chemical composition: The chemical composition of meat was based on determination of moisture, fat, ash and protein content. To determine water content, a 2-3 g aliquot of each sample of meat was weighed to the nearest 0.001 g using a Mettler Toledo electronic balance (Greifensee, Switzerland) and placed into a metallic cup (IngoLab, Moscow, Russia). It was then dried for 1 h, in a drying oven (SNOL 67/350; Umega, Utena, Latvia) at 150° C . The moisture content was calculated using Eq. 1, according to the standard GOST 9793-74[13] and GOST R 51479-99[14].

$$x_1 = \frac{m_1 - m_2}{m_1 - m} \times 100 \quad (1)$$

where, x_1 is the moisture content (%), m_1 is the weight of the sample with cup before drying (g), m_2 is the weight of the sample with cup after drying (g) and m is the weight of the cup alone (g).

After determining the moisture, each dried sample was moved to a glass cup. Then, 15 mL of ethyl ether (100% chemically pure; Skat, Almaty, Kazakhstan) was poured into the glass cup and the contents were mixed for 3-4 min. During the extraction process, the organic fraction containing the fat residues was poured out and replaced with fresh ethyl ether. After 4-5 repetitions, the residual ethyl ether was evaporated at room temperature. The metallic cup containing the fat-depleted sample was dried at 105°C for 10 min. The fat content was calculated according to the standard GOST 23042-86[15] using Eq. 2.

$$x_2 = \frac{m_1 - m_2}{m_0} \times 100 \quad (2)$$

where, x_2 is the fat content (%), m_1 is the weight of the cup and dry sample before extraction (g), m_2 is the weight of the

cup and sample after extraction (g) and m_0 is the weight of the cup alone (g).

In order to obtain the ash content, the sample from which the fat was extracted was placed into a weighed and preheated (to 150° C) crucible (50 cm^3; Mankor, Kiev, Ukraine). Then, 1 mL of magnesium acetate (98% purity; Labofarma, Almaty, Kazakhstan) was added to the crucible and burned on an electric hot plate. After that, it was placed into a muffle furnace set at 500-600° C (SNOL 7.2/1100; Umega) for 30 min. The ash content was calculated using Eq. 3:

$$x_3 = \frac{m_1 - m_2}{m_0} \times 100 \quad (3)$$

where, x_3 is the ash content (%), m_1 is the weight of the ash (g), m_2 is the weight of the magnesium oxide obtained after mineralization of the magnesium acetate (g) and m_0 is the weight of the sample alone (g). Protein content was assayed according to the GOST 25011-81[16] standard and calculated using Eq. 4:

$$x = 100-(x_1+x_2+x_3) \quad (4)$$

where, x is the protein content (%), x_1 is the moisture content (%), x_2 is the fat content (%) and x_3 is the ash content (%).

Amino acid determination: A Shimadzu LC-20 Prominence liquid chromatography system (Shimadzu, Japan) equipped with fluorometric and spectrophotometric detectors was used to quantify amino acid content. A SUPELCO C18 chromatographic column (5 µm diameter; Sigma-Aldrich, St. Louis, USA) with a surface area of 200 m^2 g^{-1} was used and chromatographic analysis was performed under a linear gradient with eluent flow rate of 1.2 mL min^{-1} and a column heated in an oven to 400°C. Amino acids were detected by fluorometric and spectrophotometric detectors at 246 and 260 nm following acidic hydrolysis and treatment with a phenylisothiocyanate solution in isopropyl alcohol to give phenylthiohydantoin.

Statistical analysis: The statistical analysis was performed using the free software R 3.02 (R Core Team)[17]. The differences between samples were evaluated using the t-test which were considered to be statistically significant at $p \leq 0.05$.

RESULTS AND DISCUSSION

In this study, the chemical composition of turkey meat of two age groups (3-4-months-old and 6-12-months-old) was analyzed. The selection of these age groups is caused by practical experience of turkey breeding for slaughter. Turkeys at 3-4 months of age have started to be fattened for slaughter at 5-6 months. This fattening period of turkeys leads to achieving the necessary weight. The results presented in Table 1 show that red turkey meat is more fatty and, therefore, higher in calories. White meat contains almost two-times less fat but more protein and minerals. Thus, white turkey meat can be considered a dietary food.

Table 2 shows that turkey meat contains all of the essential amino acids necessary for life. However, white meat has higher amounts of these amino acids than red meat, confirming that white meat possesses better dietary properties. The essential amino acid contents in both red and white meat from 6-12-months-old turkeys is higher than that in 3-4-months-old turkey meat. Thus, turkey meat products have high nutritional value and provide the human body with quality proteins and fats, as well as minerals and vitamins.

Table 3 shows that both types of turkey meat in both age groups contain vitamin A, B1, B2 and B5. The content of vitamin A in meat from 3-4-months-old turkeys was twice that of 6-12-months-old turkeys, whereas the content of the other three vitamins increased slightly with age. Furthermore, vitamins were found in 6-12-months-old turkey meat that were absent in 3-4-months-old meat, such as vitamins E, B3 and B6.

Previously, Kazhybayeva *et al.*[18] used turkey meat for production of sausages and found that it contained 19.5% protein, 22.6% fat, 2.3% ash and 55.3% moisture. These values are comparable to those obtained from the current study of turkey meat sampled from the local farms in Eastern Kazakhstan. Tcsvetkova[19] reported that white turkey meat contained 20.2% protein, 20.0% fat, 0.8% ash, 0.5% carbohydrates and 58.5% moisture. Conversely, results of present study showed the fat content was two-times lower in the white meat of 6-12-months-old turkeys, while the protein, moisture and ash content were slightly higher. Jukna *et al.*[10] reported a significantly lower fat content (1.21%) in the meat of 5-months-old turkeys, although it was rich in protein (22.19%).

Gasilina[20] examined the chemical composition of commercial and backyard turkey meat and showed that the water content of white meat from backyard turkeys was 1.59% lower than that of commercial turkey meat. The protein content of white meat varied from 18.89% in commercial to 22.37% in backyard turkeys; red meat contained 18.38 and 19.17% protein in commercial and backyard turkeys, respectively. Moreover, they reported their turkey meat samples contained 2.44% (commercial) and 2.76% (backyard) fat and 1.08% (commercial) and 1.04% (backyard) ash.

Table 1: Chemical composition of red and white turkey meat

	3-4 months-old turkeys		6-12 months-old turkeys	
Parameters	Red meat (g/100 g)[#]	White meat (g/100 g)	Red meat (g/100 g)	White meat (g/100 g)
Water	57.3±0.01	64.5±0.01	56.9±0.01	63.8±0.01
Protein	19.5±0.04*	21.4±0.04*	18.8±0.04	21.7±0.04
Fat	20.3±0.01*	11.4±0.01*	21.7±0.01	12.0±0.01
Ash	0.9±0.01	1.3±0.01	0.9±0.01	1.1±0.01

[#]g/100 g of total edible meat for all samples

*Significantly different by t-test ($p<0.05$). Results are presented as the Mean±Standard Deviation of turkey samples (N = 10)

Table 2: Amino acid composition of red and white turkey meat

	3-4 months-old turkeys		6-12 months-old turkeys	
Amino acids	Red meat (g/100 g)[#]	White meat (g/100 g)	Red meat (g/100 g)	White meat (g/100 g)
Valine	0.67±0.01	0.78±0.01*	0.96±0.03	1.05±0.01*
Isoleucine	0.56±0.01	0.70±0.01	0.97±0.03	1.12±0.02
Leucine	1.21±0.02	1.30±0.01	1.61±0.04	1.94±0.01
Lysine	1.45±0.02	1.78±0.03	1.71±0.03	2.1±0.01
Methionine+cysteine	0.56±0.01	0.61±0.01	0.65±0.01	0.84±0.01
Threonine	0.55±0.01	0.61±0.01	0.76±0.01	0.89±0.01
Tryptophane	0.29±0.01	0.42±0.01	0.31±0.01	0.52±0.01
Phenylalanine+tyrosine	1.23±0.02	1.58±0.01	1.47±0.05	1.96±0.02

[#]g/100g of total edible meat for all samples

*Significantly different by t-test ($p<0.001$). Results are presented as the Mean±Standard Deviation of turkey samples (N = 10)

Table 3: Vitamin composition of red and white turkey meat

	3-4 months-old turkeys		6-12 months-old turkeys	
Vitamins	Red meat (g/100 g)[#]	White meat (g/100 g)	Red meat (g/100 g)	White meat (g/100 g)
Vitamin A (retinol)	0.040±0.001	0.040±0.001*	0.020±0.001	0.020±0.001*
Vitamin E (tocopherol)	-	-	0.36±0.01	0.24±0.01
Vitamin C (ascorbic acid)	-	-	-	-
Vitamin B_1 (thiamine)	0.060±0.001	0.060±0.001	0.070±0.001	0.080±0.001
Vitamin B_2 (riboflavin)	0.19±0.01	0.17±0.01	0.23±0.01	0.20±0.01
Vitamin B_3 (pantothenic acid)	-	-	0.71±0.01	-
Vitamin B_4 (choline)	-	-	-	-
Vitamin B_5 (niacin)	7.60±0.07	7.60±0.09	7.80±0.13	8.0±0.05
Vitamin B_6 (pyridoxine)	-	-	0.33±0.01	0.33±0.01

[#]g/100g of total edible meat for all samples

*Significantly different by t-test ($p<0.05$). Results are presented as the Mean±Standard Deviation of turkey samples (N = 10)

In a study conducted by Ivanov *et al.*[21], it was shown that the protein, fat and ash content in turkey meat varied from 24-25%, 0.3-1.0% and 1.2-1.6%, respectively. Hence, Turkey meat has favorable dietary nutrition, especially for elderly people. While the white meat contains more protein and less water than red meat. Furthermore, the white meat is more tender than the red meat due to the structure and content of the muscle tissue, which contains less connective tissue. The physiological requirements of elderly people are very different from that of younger individuals. Therefore, it is necessary to develop a new variety of food products that consider the protein, fat, carbohydrate, fatty acid, essential amino acid, vitamin and mineral requirements of elderly people.

CONCLUSION

It is concluded that white turkey meat in Kazakhstan has highly valuable dietary properties, including a low fat content and high protein and essential amino acid content. However, the vitamin composition of white and red meat does not significantly differ. Furthermore, meat from 6-12-months-old turkeys has a higher content of essential amino acids and some vitamins versus younger turkeys.

SIGNIFICANCE STATEMENTS

The current study investigated the nutritional value of white and red turkey meat in Kazakhstan and found it to be

beneficial for low-fat diets and elderly people. Amino acid composition analysis showed that the fattening period is beneficial for increasing the level of essential amino acids in protein of white and red turkey meat. This study will help food researchers to develop new types of meat products based on the nutritive and biological value of turkey meat.

ACKNOWLEDGMENTS

The authors would like to thank the staff of the Scientific Center of Radioecological Research Engineering Laboratory of Shakarim State University of Semey (Republic of Kazakhstan) for conducting the analysis.

REFERENCES

1. Timoshenko, N.V., D.S. Shhalahov and A.A. Nesterenko, 2015. Development of raw material resources base of meat industry, forecast for the future. Molodoj Uchenyj, 5: 56-60, (In Russian).
2. Davleev, A.D., 2004. Mechanically deboned poultry meat. Alfa-Dizain, (In Russian).
3. Sokolov, A.A., D.V. Pavlov and A.S. Bolshakov, 1970. Technology of Meat and Meat Products. Pishevaya Promyshlennost, Moscow.
4. Essary, E.O. and S.J. Ritchey, 1968. Amino acid composition of meat removed from boned turkey carcasses by use of commercial boning machine. Poult. Sci., 47: 1953-1955.
5. Ahmed, T., S.A.M. Saeed and H.A. Hussien, 2013. Evaluation of poultry meat safety based on ISO 22000 as food safety management system. Pak. J. Nutr., 12: 121-129.
6. Biesalski, H.K., 2005. Meat as a component of a healthy diet-are there any risks or benefits if meat is avoided in the diet? Meat Sci., 70: 509-524.
7. Barbut, S., 2002. Poultry Meat Processing and Product Technology. Poultry Products Processing: An Industry Guide. CRC Press, Boca Raton, FL., pp: 1-30.
8. Baggio, S.R., E. Vicente and N. Bragagnolo, 2002. Cholesterol oxides, cholesterol, total lipid and fatty acid composition in turkey meat. J. Agric. Food Chem., 50: 5981-5986.
9. Alekseev, F.F., 2005. Turkey-prospect poultry meat. Ptica i Pticeprodukty, 5: 12-15, (In Russian).
10. Jukna, V., J. Klementaviciute, E. Meskinyte-Kausiliene, N. Peciulaitiene, M. Samborskyte and L. Ambrasunas, 2012. Comparative evaluation of quality and composition of ostrich, turkey and broiler meat. Biotechnol. Anim. Husband., 28: 385-392.
11. Apraksina, S.K., 2007. Poultry, poultry meat and problems of processing. Mjasnye Tehnol., 2: 56-57, (In Russian).
12. Antipova, L.V., A.Y. Gizatov and L.A. Zubairova, 2004. The ways of rational use of nontraditional meat with application of biotechnology treatments methods. Rational Nutr. Food Addit. Biostimulators, 3: 21-24, (In Russian).
13. GOST 9793-74, 2010. Meat products. Method of moisture determination. Standardinform, Moscow, 2010.
14. GOST R 51479-99, 2010. Meat and meat products. Method for determination of moisture content. Standardinform, Moscow, 2010.
15. GOST 23042-86, 2010. Meat and meat products. Method of fat determination. Standardinform, Moscow, 2010.
16. GOST 25011-81, 2010. Meat and meat products. Method of protein determination. Standardinform, Moscow, 2010.
17. R Core Team, 2013. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna.
18. Kazhybayeva, G.T., B.K. Assenova, S.K. Kassymov, F.K. Smolnikova, G.N. Nurymkhan and A.N. Nurgazezova, 2012. Functional multicomponent meat products development. Proceedings of the International Scientific and Practical Conference Dedicated to the Memory of A.V. Gorbatov, Volume 5, (SP'12), Moscow, pp: 172-175.
19. Tcsvetkova, A.M., 2012. Formation of consumer performance of turkey meat products. Ph.D. Thesis, Moscow State University, Moscow.
20. Gasilina, V.A., 2012. Veterinary-sanitary expertise of commercial and backyard turkey meat from Krasnoyarsk region. Ph.D. Thesis, Department of Veterinary, Siberian Federal University, Krasnoyarsk, Moscow.
21. Ivanov, S., V. Pasichniy, I. Strashynskyi, A. Marynin, O. Fursik and V. Krepak, 2014. Meat products from turkey meat with texture-forming fillers. Food Chem. Technol. (Maisto Chemija ir Technologija), 48: 25-33.