Current state of turkey meat production in the world and in Bulgaria – A review

Pavlina Hristakieva*
Agricultural Academy, Agricultural Institute – Stara Zagora 6000, Bulgaria
*E-mail: poly_31@abv.bg

Citation: Hristakieva, P. (2021). Current state of turkey meat production in the world and in Bulgaria – A review. *Zhivotnovadni Nauki*, *58*(3), 42-49 (Bg).

Abstract

The good qualities combined with the high economic efficiency are the factors for increasing the production and consumption of turkey meat worldwide. Turkeys is becoming an increasingly popular source for poultry meat. Undoubtedly, such a great advance in breeding improves the profitability of turkeys rearing and makes the meat of this species a food product available to an ever increasing group of consumers. There is no large production of broiler turkeys in Bulgaria, the small amount being grown only on private farms. In recent years, there has been a decrease in the number of turkeys, with meat consumption per capita being around 0.5 kg. Despite many attempts, our country is still unable to organize a sufficiently efficient production of turkey meat, which is a prerequisite for an increase in imports of turkeys products.

Key word: turkeys, meat yield, production turkey meat, consumption turkey meat

Състояние на производството на пуешко месо в света и в България

Павлина Христакиева*
Земеделски Институт – Стара Загора
*E-mail: poly_31@abv.bg

Резюме

Добрите качества на пуешкото месо, съчетани с високата икономическа ефективност, са факторите за увеличаване на производството и консумацията му в световен мащаб. Пуйките стават все по-популярен източник за птиче месо. Несъмнено това предопределя голям напредък в развъждането, подобрява рентабилността на отглеждането на пуйки и прави месото от този вид хранителен продукт, достъпен за постоянно нарастваща група потребители. В България няма голямо производство на бройлери-пуйки, като малкото количество се отглежда в частни ферми. През последните години се наблюдава спад в броя на пуйките, като консумацията на месо на глава от населението е около 0,5 кг. Въпреки многото опити страната ни все още не е в състояние да организира достатъчно ефективно производство на пуешко месо, което е предпоставка за увеличаване на вноса на пуешки продукти**.**

Ключови думи: пуйки, добив на месо, производство на пуешко месо, консумация на пуешко месо

Introduction

The turkey (*Meleagris gallopavo*) is a poultry of the class: Aves, family: Phasianidae, subfamily: Meleagridinae genus Meleagris, Species *M. Gallopavo*. She was desperate in Mexico (Central America) about 2000–2500 BC (Scanes, 2011). In Europe, it was brought to the beginning of the 16th century. Its good and economic qualities make it the preferred source of meat in the various geographic latitudes worldwide. Turkeys were first used for meat by Native Americans by about AD 1100. Compared to wild turkeys, domestic turkeys are selectively bred to grow larger in size for their meat.

The most important priority in the world has to be human health. For this reason people will prefer diets with content low cholesterol and fat. Turkey meat is an ideal choice with its special taste, aroma and quality. Turkey meat is an excellent source of protein of an animal origin, and also contains phosphorus, vitamins of the B, PP group, and minerals (Baggio et al., 2002). Turkey meat is an essential part of healthy eating due to its dietary, hypoallergenic, safe and nutritive properties (Lisitsyn et al., 2018). Turkey meat is rich in B group vitamins, which help to prevent anemia maintain the normal functioning of the cardiovascular and nervous system (Amirkhanov et al., 2017). The nutrition and biological value of this meat are defined by the content of essential amino acids, their ratio, and also good digestibility (Klementavičiūtė et al., 2002). Turkey meat favorably differs in its high nutritive taste and culinary qualities. It contains a large amount of protein (28% against 14–18% in other poultry meat) and a moderate amount of fat (2–5%), rich in vitamin of group B and has the lowest level of cholesterol in comparison with other types of meat (Amirkhanov et al., 2017; Okuskhanova et al., 2017). White meat from skinless turkey breast has a low fat content, approximately 1.0% (Laudadio et al., 2009; Mikulski et al., 2012). White and red turkey meat has small differences in fatty acid composition. The total amount of saturated and polyunsaturated fatty acids is higher in red meat, while monounsaturated fatty acids predominate in white meat (Igenbayev et al., 2019). Dark meat from turkey legs is richer in fat, which is why most of dietary polyunsaturated fatty acids (PUFAs) are transferred to the leg muscles (Betti et al., 2009; Zuidhof et al., 2009; Jia and Slominski, 2010). It was demonstrated that linoleic acid was preferentially deposited in dark meat while long-chain n-3 fatty acids in white meat (Gonzales-Esquerra and Leeson, 2000).

The consumption of turkey meat in the world is steadily increasing as whole. Over the past two decades, there has been a rapid development of poultry farming in all countries of the world, which is a consequence of the high economic efficiency of production and the biological value of the poultry products – eggs and meat. The turkey is becoming an increasingly preferred source for poultry meat. In Bulgaria the relative share of farmed turkeys is about 0.6%, and every year there is a decrease.

As a healthy nutritious source turkey meat will become as sought in Bulgaria as it does in the whole world.

Production of turkey meat in the world

Poultry transform feed into animal protein very rapidly. Poultry consumption in the developing countries is projected to grow at 3.4% per annum to 2030, followed by beef at 2.2% and ovine meat at 2.1%, and other meats growing at 1.7% or less (FAO, 2007). The environmental impact of poultry production is a continuing challenge and it is predicted that global consumption of poultry meat will increase between 2000 and 2030 at an average annual rate of 2.51% (Fiala, 2008). Turkey production is an important and highly profitable agricultural industry with a rising global demand for its products (Yakubu et al., 2013), and they are adaptable to wide range of climatic conditions (Ogundipe and Dafwang, 1980). Turkey bird has a promising potential to be an alternative to livestock in meat production (Nixey, 1986). In the context of competitive feeding and management cost different countries searched such alternative source for protein. With the continued rise in the cost

of production of cattle, sheep and goat, which are the primary sources of animal protein in the world, it has become very necessary to explore efficient and less common but potential sources of animal protein for economic viability. Male and female British United Turkey reached, at 16 weeks of age, 14.60 kg and 10.25 kg, respectively (BUT, 2005). Moreover, the turkey has high dressing percentage that could amount to 87% of slaughter weight (Turkey management guide, 2012). Nowadays turkeys are slaughtered at higher weights. Weights of male turkeys from 22 to 24 kg are no exception. Ten years ago this was four or five kg less. This trend is especially yield-driven because the higher the weight the lower the processing cost per kilo and the higher the meat yield. But the high weights are an increasing problem from a welfare point of view.

In the production of turkey meat, the lines involved in obtaining the hybrids, as well as the growth of the commodity turkeys themselves, have a significant influence. Meat yield, terms of realization and economic efficiency of fattening depend on this. Nowadays, the production of broiler turkeys is based on two or three crossings of lines, in which the father line is a heavy type and the mother line is a light or medium type (Hattenhauer, 1986). Generation breeding works have led to the development of turkey strains and lines designed for commercial rearing of hybrids with a fast growth rate, high body weight values and a low feed conversion ratio (Nestor, et al., 2008). Budnik and Burek (2009) report that only within the last ten years the body weight value of turkey males of heavy lines increased by 13.4%, and that of turkey females by 11%.

In the wide practice for industrial production of turkey meat are used hybrids, which are characterized by high growth intensity, high feed conversion, very good quality meat, suitable for deep processing. The best parent forms for obtaining hybrids are now selected by the companies Nicholas in the USA, BUT in England, Hybrid in Canada, Kulen in France and others. (Stoimenov, 2003)

Today, half of the worldwide production of eggs and turkey are produced by animals from Hendrix Genetics, Netherlands. Hendrix Genetics' have three bred varieties: the Hybrid Grade Maker (GM), the XL Hybrid and Hybrid Converter. The GM is the market that requires a lighter turkey, the XL sales channels for heavy turkeys. Both have about 10% market share. The Converter is in between and is the most common. Today, attention is paid to the breeding of so- named "Traditional Poultry". Part of the breeding of turkeys specializes in the selection of several slow-growing turkeys (also with different colors of feathers). Like slow-growing broilers, there is a "turkey of tomorrow", as it is named in the Netherlands – this turkey not only grows a little slower, but is also healthier and has better meat quality.

In 2016, the world market for turkey meat increased to 6.2 million tonnes. At wholesale prices, the market reaches $ 13.5 billion in 2016, rising by 3.6 percent annually from 2007 to 2016; however, there is a mixed trend (rising and rising) in terms of overall consumption figures. The significant increase in demand for turkey meat in 2008 (16% on an annual basis) was followed by a sharp decline in 2009 (86% on an annual basis). World consumption of turkey meat is expected to reach 6.7 million tonnes by 2025.

Turkey turkey meat is a product of steady demand in North America, Europe and Latin America, but the per capita consumption level varies from country to country. Consumption of turkey meat is largely determined by per capita income and seasonality (official holidays and Christmas) so that in countries with a high standard of living traditionally higher turbot consumption per capita. On the other hand, rising living standards and rapid urbanization, the growing popularity of Western diets in Asia, and greater attention to lower fat intake have led to a significant increase in turkey production and consumption worldwide over the last decades.

The United States and major European countries are major markets for turkey meat. The US (2,519,000 tons) is the largest user of turkey meat, which accounted for only 41% of world consumption. Followed by Brazil (8.1%), Germany (8.0%), France (5.5%), Italy (4.4%), Russia (3.7%), Spain (3.0%), Mexico (2.8%), the UK (2.7%), Canada (2.3%), Israel (1.5%), Chile

(1.4%), Tunisia (1.2%). The other countries together make up about 15% of global consumption.

The highest annual growth rates of turkey consumption from 2007 to 2016 are registered in Spain, 19.2% per year, Russia 8.5% and Brazil 5.4% annually. Consequently, Brazil, Russia and Spain increased their shares in terms of world poultrymeat consumption by 2 percentage points each from 2007 to 2016.

Among the leading consumer countries, high per capita consumption levels of consumption are recorded in Israel (11.5 kg/year in 2016) and in the US (7.8 kg/year), which are significant higher than the world average of 0.8 kg per year. In these countries, per capita consumption declined slightly between 2007 and 2016.

The production of turkey meat reached 6.3 million tonnes in 2016, with the overall upward trend. That figure was 482,000 tonnes (or 8 percent) more than the previous year and 797,000 tonnes (or 14 percent) more than the initial level. In terms of value, the overall expansion of world production is from 9.8 billion dollars in 2007 to

Table 1. Turkey production in EU and third countries ('000 tons carcass weight)*

Countries/year	2013	2014	2015	2016	2017	2018
Austria	22	21	20	22	22	22
Belgium/Luxembourg	9	8	8	8	8	8
Bulgaria	1	1	1	0	0	0
Croatia	9	10	13	13	12	13
Cyprus	0	0	0	0	0	0
Czech republic	5	5	6	9	7	7
Denmark	2	2	1	1	1	1
Finland	7	7	8	8	8	9
France	359	366	355	382	369	355
Germany	384	392	396	407	387	360
Greece	3	3	3	3	3	3
Hungary	89	93	97	101	97	98
Ireland	28	26	26	26	25	27
Italy	314	310	313	331	309	300
Malta	0	0	0	0	0	0
Netherlands	28	28	28	28	28	28
Poland	280	280	312	-	376	384
Portugal	39	37	38	38	40	42
Romania	10	11	12	10	10	15
Slovakia	0	0	0	1	1	1
Slovenia	4	4	5	5	5	6
Spain	177	181	171	187	200	235
Sweden	4	4	4	4	5	6
United Kingdom	187	172	177	164	151	158
EU	1.958	1.961	1.992	2.096	2.063	2.074
Brazil	520	470	480	596	586	-
Canada	168	168	172	183	171	-
Mexico	17	19	19	17	16	-
Rissia	100	105	105	110	100	-
South Africa	53	53	-	-	-	-
USA	2.634	2.611	2.552	2.713	2.713	2.372
World	5.653	5.639	5.654	6.070	5.948	5.980

**Source: AVEC, 2019*

13.5 billion dollars in 2016. However, the trend is not entirely consistent: the value of production declined by 14% in 2009 , recovering over the next two years until 2016.

The United States produces 43% of the world's turkey meat production and remains the main country producing turkey meat with a production of about 2.7 million tonnes in 2016, accounting for 43% of the world's total production. Other major producers are Brazil (9%), Germany (8%), France (6%), Italy (5%), Russia (4%), Spain, Poland, Canada and the United Kingdom. In the US, production levels have declined somewhat in 2009, but are gradually recovering, returning to baseline in 2016. The highest growth rate for turkey production was observed in Spain (25.9% in 2007–2016) and Russia (22.3%). Zimnyakov and Dmitrieva, (2018) was noted that the production of turkey meat (carcass weight) in poultry farms in Russia from 2006 to 2017 increased by 3.5 times – from 78.1 thousand tons to 276.3 thousand tons.

According to a report by AVEC, 2019 turkey sector standing at 5.98 million tonnes (carcass weight equivalent), global turkey meat production remained fairly stable in 2018 compared with 2017 (up +0.54%), but while US production declined (-1.53%), production in Europe increased (+0.53%). Turkey production in Europe is still concentrated in six Member States (Poland, Germany, France, Italy, Spain and the United Kingdom). With roughly 1.8 million tonnes produced, these countries represent 86% of total EU turkey meat production. The total production of these six Member States did not change between 2017 and 2018, but while Germany, France and Italy reduced production, Poland, Spain and the United Kingdom increased theirs (Table 1).

Approximately 17% of world turkey meat production is for export. Turkey's meat is traded and the share of world production exports is approximately 16–18% between 2007 and 2016. The high intensity of trade is mainly determined by significant distances between major turkey production areas and some major consumers. The turkey meat will continue to be highly traded as there is constantly growing consumption and intense global and regional integration.

Production of turkey meat in Bulgaria

These trends are not valid for Bulgaria. Production of turkey broilers is not yet organized, with the small amount grown in small farms.

Total production of poultry meat for 2014 is estimated at about 101.5 thousand tons in Bulgaria. On the basis of the preliminary data of the Agricultural Production Department of Ministry of Agriculture, Food and Forestry for production and National Statistical Institute for import and export of poultry meat, the domestic consumption of poultry meat for 2014 is estimated at 158.4 thousand tons. This is about 5.7% more than in the previous year, as a result of the combination of higher production and net imports growth (the increase in imports in terms of quantity exceeds that of exports (NSI, 2017).

Domestic consumption of poultry meat for 2016 is estimated at 170.5 thousand tons. An average of 10.8 kg is the average consumption of poultry meat from a household, however, it is 3.6% below the level of the previous year. According to NSI data on import and export of meat from poultry. In the period 2010–2016 the annual consumption of poultry meat from households is kept at a level of about 11 kg per person, accounting for about one third of the total consumption of meat from households.

Due to the low production of turkey meat in the country, the export of this type of meat is traditionally limited, most of which is re-export. In the eleven months of 2014, exports of 2 477 tonnes of turkey meat were reported, 23.3% less than in the same period of the previous year. The quantities are mainly for Greece (2 263 tonnes).

Significant quantities of turkey meat are imported every year because its production in Bulgaria is not enough to cover domestic demand. Mainly frozen cuts are delivered for the needs of the processing industry. By November 2014, 7 632 tonnes of turkey meat and offal had been imported into the country. This is 13.8% more than the same period in 2013.

The country is looking for turkeys only when the weather is cold and year-round is very low demand for turkey. We produce only about 60 tonnes of turkey a year. Consumption occupies

0,1% of the total meat consumption or about 10–15 tons per year. The remaining quantity goes to export. Per capita consumption of turkey meat is less than 0.5 kg per year. The maximum annual production we can make in the country is 10 to 15 thousand turkeys.

The price of turkey meat is very high. For feeding small turkeys, very expensive components are required, including a large amount of protein, and cultivation is very expensive for manufacturers. Problems in turkey farming in Bulgaria are the high cost of turkey meat. This is related to the requirements for high protein feeding, heating at the early growing on the one hand and placement of production.

The turkey-broilers is characterized by high intensity of growth and development and good feed conversion. Numerous studies have concluded that turkeys have intensive growth at a young age and retain this quality for a long time (Stoychev and Krasteva, 2001). The formation of muscle tissue corresponds to the increase in weight of birds at an early age and goes in an ascending line – for broiler turkeys up to 90 days of age after which the growth rate decreases and fat deposition begins (Donchev et al., 1981). Lalev (1993) studying the meat productivity of turkeys, observed that in the period 13–15 weeks the average daily growth reaches its peak and decreases in 16–20 weeks.

The performance of the newer hybrid is 3.1–3.2 times better than hybrids bred in the 1960s. Slaughter traits have a 13–18% improvement and breast meat production has increased by 10% (Herendy et al., 2003; Nixey, 2002). At studyng Oblakova et al. (2008) of the productivity of turkeys where were products of artificial insemination on turkeys, aged 36 weeks of the Layer Light (LL) strain reported for body weight at 16 weeks age – 6775 kg for turkeys male and 4850 kg for turkeys female. The turkey has very good slaughter traits, which outperforms all other domestic animals and farm birds. In our studies Hristakieva, 2006 slaughter yield (%) of turkey broilers obtained from parental lines of turkeys has a carcass yield of 70,24% to 72,28% in male turkeys and 70,08% to 73,94% in female turkeys. Oblakova et al. (2009) reported slaughter rate for male turkeys from 72.20 to 73.51% and for female turkeys from 72.27 to 73.91% at 20 weeks of age. Lalev et al. (2018) reports slaughter rate of up to 81.35% in turkey broilers. And Al Hafiz Abdelrahman Hassan et al. (2014) observed in both systems (extensive and semi intensive systems) turkeys gave 86.03 and 87.44, dressing percentage in the extensive and semi intensive systems respectively at week 28 and 76.75 and 78.44 at week 16. The results in the selection of turkeys are remarkable, especially in terms of increasing the relative share of breast meat, which allowed the turkey meat to compete successfully with red meat both in the sausage industry and in the production of delicacies (Bentley, 1999). Bakalivanova et al. (2000, 2001) reported a higher proportion of breasts in turkeys of the total slaughter weight – 31.72% compared to that of broiler chickens – 29.28%. In a slaughter analysis of broiler turkeys BUT Oblakova (2004) found a higher yield of females 78.24% to 74.74% of males. The content of pectoral muscles in the grill compared to males is higher by 2.11% points. In addition to high growth and slaughter results, turkeys are distinguished by meat with high nutritional value. The dietary value of turkey meat is primarily due to its high protein content and low fat content, which has been confirmed by a study by a number of authors. Along with the high protein level up to 32.4%, turkey meat is characterized by a high mineral content of 1.17–1.2% (Ribarski et al., 2001). Bachev (1967) also notes that the high protein content and low fat content in both white and red meat is maintained for a long period, in this case up to 20 weeks of age, something that is not observed in other types of domestic birds. Oblakova et al., 2016 reported for protein content in breast and thigh muscles 23.03% and 20.73% for female and the content of protein in the males breast and thigh muscles – 23.04% and 21.74%, respectively at turkeys broilers (MHxLL).

Conclusion

The good growth and meat qualities, combined with high economic efficiency are the fac-

tors for increasing the production and consumption of turkey meat worldwide. Unfortunately in Bulgaria turkeys breeding after significant advances in the past is now largely left to turkeys breeding in separate rural yards, with quite low productivity. However, in the last few years, the industrial development of turkey breeding has been gaining momentum, albeit on a more moderate scale. This gives hope that the turkeys breeding in Bulgaria will develop alongside the increased interest in the assortment of this useful production, including export.

References

Al Hafiz, A. H., Gibril, S., , Shamseldin, R. M., Yassin, O. E., & Mukhtar A. & Eltrefi, A. M. A (2014). Performance traits of turkeys under extensive and semi intensive systems of management (17-28 weeks) in Khartoum state *U. of K. J. Agric. Sci. 22(2),* 83-98.

Amirkhanov, K., Igenbayev, A., Nurgazezova, A., Okuskhanova, E., Kassymov, S., Muslimova, N., & Yessimbekov, Z. (2017). Comparative analysis of red and white turkey meat quality. *Pakistan Journal of Nutrition*, *16*(6), 412-416.

Baggio, S. R., Vicente, E., & Bragagnolo, N. (2002). Cholesterol oxides, cholesterol, total lipid, and fatty acid composition in turkey meat. *Journal of agricultural and food chemistry*, *50*(21), 5981-5986.

Bachev, N. (1967). Study of the fattening abilities of turkeys of the breeds White Imperial and North Caucasian Bronze and the crosses between them. *Animal Sciences,* 4, 61-67.

Bakalivanova, T., Lalev, M., & Oblakova, M. (2000). Comparative characteristics of turkey and broiler chicken meat. *Poultry Raising*, *6*, 30-32.

Bakalivanova, T., Bakalivanov, St., Tsvetkov, Ts., Lalev, M., & Oblakova, M. (2001). Turkey meat- quality and characteristics. *Symposium of livstok production, Struga,* 131-135.

Betti, M., Perez, T. I., Zuidhof, M. J., & Renema, R. A. (2009). Omega-3-enriched broiler meat: 3. Fatty acid distribution between triacylglycerol and phospholipid classes. *Poultry Science*, *88*(8), 1740-1754.

Bentley, J. S. (1999, September). Meat characteristics of turkeys: a breeders perspective. In *Proceedings of the Fourteenth European Symposium on the Quality of Poultry Meat, Bologna, Italy* (pp. 9-28).

Budnik, S., & Burek, R. (2009). Turkeys production–chances and threats. In *XI Symp. of Poultry PTNW. Wrocław, Polska, Czerwiec* (pp. 35-40).

Donchev, R., Kaitazov, G., Kabakchiev, M., & Aleksieva, D. (1981). Guide for exercises in poultry farming. *Zemizdat, Sofia*, 27

Fiala, N. (2008). Meeting the demand: an estimation of potential future greenhouse gas emissions from meat production. *Ecological economics*, *67*(3), 412-419.

Hattenhauer, H. (1986). Perspektywy rozwoju hodowli I chowu indykow. *Drobiarstwo*, *34*(1), 3- 6

Herendy, V., Sütő, Z., & Horn, P. (2003). Characteristics of improvement in the turkey production in the last 30 years. *Agriculturae conspectus scientificus*, *68*(2), 127-130.

Hristakieva, P. (2006). Opportunities to use lines of turkeys gene pool of producing hybrid turkey. *Dissertation PhD, 2006, Agricultural Academy, Agricultura Institute-Stara Zagora, Bulgaria*, 1-133.

Igenbayev, A., Okuskhanova, E., Nurgazezova, A., Rebezov, Y., Kassymov, S., Nurymkhan, G., Tazeddinova, D., Mironova, I., & Rebezov, M. (2019). Fatty acid composition of female turkey muscles in Kazakhstan. *Journal of World's Poultry Research*, *9*(2), 78-81.

Jia, W., & Slominski, B. A. (2010). Means to improve the nutritive value of flaxseed for broiler chickens: The effect of particle size, enzyme addition, and feed pelleting. *Poultry science*, *89*(2), 261-269.

Johnsan, R. (2018). Global turkey meat market: Key findings and insights. *The Poultry site.* (http://www.thepoultrysite.com/poultrynews/40083/global-turkey-meat-market-key-findings-and-insights/)

Jukna, V., Klementavičiūtė, J., Meškinytė-Kaušilienė, E., Pečiulaitienė, N., Samborskytė, M., & Ambrasūnas, L. (2012). Comparative evaluation of quality and composition of ostrich, turkey and broiler meat. *Biotechnology in Animal Husbandry*, *28*(2), 385-392.

Lalev, M. (1993). Study of the genetic parameters in turkeys and development of a selection program, *Dissertation PhD, Agricultural Academy , Sofia, Bulgaria.*

Lalev, M., Mincheva, N., Hristakieva, P., & Oblakova, M. (2018). Effect of dietary inclusion of rümanol ml vegetable fat on fattening hybrid turkey broilers. *Trakia Journal of Sciences*, *16*(4), 321.

Laudadio, V., Tufarelli, V., Dario, M., D'emilio, F. P., & Vicenti, A. (2009). Growth performance and carcass characteristics of female turkeys as affected by feeding programs. *Poultry Science*, *88*(4), 805-810.

Lisitsyn, A. B., Semenova, A. A., Kuznetsova, T. Y. G., Dydykin, A. S., & Nasonova, V. V. (2018). Study of the effect of sex and type of muscles on the development of quality defects in turkey meat after the slaughter. *Foods and Raw materials*, *6*(1), 63.

Mikulski, D., Jankowski, J., Zdunczyk, Z., Juskiewicz, J., & Slominski, B. A. (2012). The effect of different dietary levels of rapeseed meal on growth performance,

carcass traits, and meat quality in turkeys. *Poultry Science*, *91*(1), 215-223.

Nestor, K. E., Anderson, J. W., Patterson, R. A., & Velleman, S. G. (2008). Genetics of growth and reproduction in the turkey. 17. Changes in genetic parameters over forty generations of selection for increased sixteen-week body weight. *Poultry science*, *87*(10), 1971-1979.

Nixey, C. (1986). A comparison of growth and fat deposition of commercial avian species. In *7th European Poultry Conference, Paris, August* (pp. 24-28).

Nixey, C. (2002). Trends in Turkey production. *11th European Poultry Conference, Germany*

Oblakova, M. (2004). Study of growth potentials and slaughter analysis of BUT-9 broiler turkey poults. *Bulgarian Journal of Agricultural Science (Bulgaria)*. 10, 137-142

Oblakova, M., Lalev, M., Hristakieva, P., & Georgieva, S. (2008). Effect of egg weight on the productive traits of hatched turkey poults not later than 16 weeks of age. *Trakia Journal of Sciences*, *6*(4), 83-87.

Oblakova, M., Ribarski, S., Oblakov, N., & Hristakieva, P. (2016). Chemical composition and quality of turkey-broiler meat from crosses of layer light (ll) and meat heavy (mh) turkey. *Trakia J. Sci*, *2*, 142-147.

Oblakova, M., Hristakieva, P., & Lalev M. (2009). Slaughter analysis on turkeys hatch from different eggs mass. *Union of Bulgarian scientist, Stara Zagora, International science conference, Stara Zagora 4-5 June 2009*, I, 162-167.

Ogundipe, S. O., & Dafwang, I. I. (1980). Turkey production in Nigeria. *National Agricultural Extension Research and Liaison Service (NAERLS) Bulletin*, *22*, 2-22.

Okuskhanova, E., Assenova, B., Rebezov, M., Amirkhanov, K., Yessimbekov, Z., Smolnikova, F., Nurgazezova, A., Nurymkhan, G., & Stuart, M. (2017). Study of morphology, chemical, and amino acid composition of red deer meat. *Veterinary world*, *10*(6), 623-629.

Ribarski, S., Lalev, M., & Oblakova, M. (2001). Physicochemical properties and micromorphological features of skeletal muscles in turkeys. *Animal Sciences*, 2, 106-109.

Scanes, C. G. (2011). Hormones and Metabolism in Poultry, *Update on Mechanisms of Hormone Action - Focus on Metabolism, Growth and Reproduction,* Prof. Gianluca Aimaretti from: http://www.intechopen.com/books/update-on-mechanisms-of-hormone-action-focuson-metabolism-growth-and-reproduction/hormones-and-metabolism-in-poultry

Stoimenov, B. (2003). Development of the world and Bulgarian poultry farming, *Poultry farming,* 6, 12-15.

Stoychev, Z., & Krasteva, M. (2001). Production of livestock products. *University publishing House "Economy", Sofia*.

Yakubu, A., Abimiku, H. K., Musa-Azara, I. S., Idahor, K. O., & Akinsola, O. M. (2013). Assessment of flock structure, preference in selection and traits of economic importance of domestic turkey (Meleagris gallopavo) genetic resources in Nasarawa state, Nigeria. *Livestock Research for Rural Development*, *25*(1).

Zimnyakov, V. M., & Dmitrieva, S. Y. (2018). The turkey meat production on the industrial basis. *Innovative technique and technology*, 3, 42-49. (Russ).

Zuidhof, M. J., Betti, M., Korver, D. R., Hernandez, F. I. L., Schneider, B. L., Carney, V. L., & Renema, R. A. (2009). Omega-3-enriched broiler meat: 1. Optimization of a production system. *Poultry Science*, *88*(5), 1108-1120.

AVEC. (2019). Annual report. www.avec-poultry.eu

BUT. (2005). British United Turkeys. Commercial Performance Goals. *5th ed. British United Turkeys Ltd, Warren Hall, Broughton, U*

FAO. (2007). The State of the World's Animal Genetic Resources for Food and Agriculture, *Edited by B. Rischkowsky and D. Pilling. Rome. K.*

NSI. (2017). Situation- perspective analysis of poultry meat and eggs. *Ministry of Agriculture, Food and Forestry, Juni*, 2017, 1-28.

Turkey Management Guide. (2012). Central poultry development organization (SR), Hessarghatta, Bangalore 560088, *Website: http://www.cpdosrbng.Kar.nic.in. Accessed in january 2016.*