

Case report

UDC: 637.54.65

<https://doi.org/10.46784/eavm.v15i1.292>

DEEP PECTORAL MYOPATHY IN BROILER CHICKEN MEAT OBTAINED FROM A SUPERMARKET - CASE REPORT, LITERATURE REVIEW AND PREVENTIVE MEASURES

Dragana Ljubojević Pelić^{1*}, Miloš Pelić¹, Jelena Vranešević¹,
Suzana Vidaković Knežević¹, Bojana Prunić¹, Nikolina Novakov²,
Milica Živkov Baloš¹

¹ Scientific Veterinary Institute "Novi Sad", Novi Sad, Republic of Serbia

² Department of Veterinary Medicine, Faculty of Agriculture,
University of Novi Sad, Republic of Serbia

Abstract

The fast growth rates in commercially reared chickens could lead to the changes in their muscle tissue structure and cause breast muscle myopathies, including deep pectoral myopathy (DPM). The incidence of DPM depends on various factors including rearing conditions, age, sex, weight and genetic strain. The aims of the present paper were to report a case of DPM in broiler chickens bought in a supermarket and review important information regarding this disease from the available literature, especially its effect on meat quality parameters and consumer preferences.

Key words: poultry meat, breast muscle myopathies, meat quality, consumer acceptability

^{1*} Corresponding Author: dragana@niv.ns.ac.rs

DUBOKA PEKTORALNA MIOPATIJA MESA BROJLERSKIH PILIĆA IZ SUPERMARKETA – PRIKAZ SLUČAJA, PREGLED LITERATURE I PREVENTIVNE MERE

Dragana Ljubojević Pelić¹, Miloš Pelić¹, Jelena Vranešević¹,
Suzana Vidaković Knežević¹, Bojana Prunić¹, Nikolina Novakov²,
Milica Živkov Baloš¹

¹ Naučni institut za veterinarstvo „Novi Sad“, Novi Sad, Republika Srbija

² Departman za veterinarsku medicinu, Poljoprivredni fakultet,
Univerzitet u Novom Sadu, Novi Sad, Republika Srbija

Kratak sadržaj

Velika brzina rasta kod komercijalno gajenih pilića može dovesti do promena u strukturi mišićnog tkiva pilića i izazvati miopatije grudnih mišića, uključujući i duboku pektoralnu miopatiju. Incidenca duboke pektoralne miopatije zavisi od različitih faktora uključujući uslove gajenja, starost, pol, telesnu težinu i genetske faktore. Cilj ovog rada je da prikaže slučaj duboke pektoralne miopatije kod brojlerskih pilića kupljenih u supermarketu i da prikaže pregled važnih informacija vezanih za ovu bolest iz dostupne literature, sa posebnim osvrtom na efekat ove bolesti na kvalitet mesa i prihvatljivost od strane potrošača.

Ključne reči: živinsko meso, miopatije grudnih mišića, kvalitet mesa, prihvatljivost od strane potrošača

INTRODUCTION

Broiler chicken meat industry is of great importance and it is well known that poultry meat is one of the main sources of protein for the people worldwide. The use of novel technologies and rapid development of genetic, farm management and nutrition are the main reasons why poultry meat industry is growing so fast. Some of the reasons for increasing demand for poultry meat are also modern trends and growing interest in healthy eating habits. However, the fast growth rate in commercially reared chickens could lead to the changes in their muscle tissue structure and cause breast muscle myopathies.

Deep pectoral myopathy (DPM) is also known as Green Muscle Disease and Oregon Disease. DPM was first described in adult turkeys by Dickinson et al. (1968), while in young broiler chickens it was first described by Richardson

et al. (1980). The appearance of unusual green color in breast meat of commercially reared poultry is typical for this condition. It has been reported mainly in turkeys, but in recent years this disease has become more common in broiler chickens. DPM is not connected with any infectious diseases or harmful substances (Pastuszczyk -Frak and Uradziński, 2009). It doesn't represent food safety concern. However, it significantly affects the visual appearance of the chicken breast meat. Furthermore, alterations in visual sensory properties of the breast meat could negatively affect consumer acceptance of chicken meat (De Carvalho et al., 2020). Also, it could lead to meat quality losses (Yalcin et al., 2018). This condition is also a significant economic problem in the poultry farming. It should be pointed out that breast muscles of broiler chickens are their economically most profitable part. Due to the fact that DPM significantly affects meat quality of commercially reared chickens and has a negative economic impact, it represents a challenge to the broiler industry.

The aims of this paper were to describe a case of DPM in broiler chickens obtained from a supermarket and review important information from the available literature. This is very important, especially because consumers need to be able to recognize this disease. Finally, some recommendations for preventive measures and monitoring of DPM in poultry meat are proposed.

CASE PRESENTATION

No ethical approval was obtained because this study did not involve laboratory animals. It only involved non-invasive procedures.

Case report - consumer complaint report

Consumers bought four "ready to grill" chickens in a supermarket and, after realizing that the breast meat had a strange color and texture, they contacted the laboratory of Scientific Veterinary Institute "Novi Sad". All chickens available at the supermarket are produced on the same broiler chicken farm. The consumers were very distressed and concerned. They found green flesh inside chicken breasts and they described it as "atypical, greenish, breast resembling vomit in color that smelled strange". They explained their surprise at the discovery, describing the meat as "absolutely disgusting". Furthermore, they said that the changes they encountered were like "finding a foreign body, a possible biological weapon" and "the emergence of a new parasite". They bought four originally packed chickens "ready to grill" and found the changes in two, while cutting the chickens into pieces, to freeze them. They claimed that they won't shop at that supermarket ever again. Additionally, they said that they had been raising chick-

ens for years and had never encountered a similar problem. Obviously, consumers identified this condition as an important health and aesthetic issue.

Organoleptic analysis

The consumers brought two carcasses of chicken meat that they bought at a supermarket to the laboratory of Scientific Veterinary Institute "Novi Sad". Sensory assessment was carried out in the laboratory.

Organoleptic characteristics of chicken meat

The changes in color were notable as green discoloration. There were also the changes in the texture of breast muscles. Bilateral macroscopic changes of breast muscle that was green in color, as well as dry, crumbly, friable and solid consistency were observed during the examination. Dry appearance was also detected on the section. Progressive degeneration of the *Pectoralis minor* muscle and the damaged muscle tissue were found. Also, the unpleasant smell of the affected tissue was detected. The meat was repulsive. The diagnosis of DPM was established on the basis of distinctive green color of the muscle tissue and overall organoleptic characteristics (Figure 1).

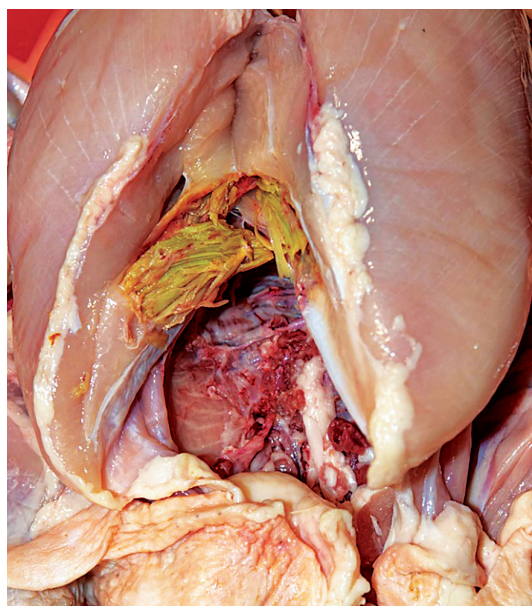


Figure 1. Green muscle disease after opening the breast muscles

DISCUSSION

The affected muscle tissue should be removed and the rest of the carcass is fit for human consumption. Due to the fact that the most valuable part of the chicken carcass is affected and removed, the quality of the product is significantly lower, which results in economic losses.

All the above mentioned indicates that there is a need to properly inform the public about such cases and conduct researches in order to prevent the unnecessary spread of fear and panic.

The main risk factors associated with the occurrence of DPM

Slaughter weight, rearing conditions, age, sex, genetics and mobility of chickens are the main factors associated with the occurrence of this disease (Petracci and Cavani, 2012). A major factor for the occurrence of DPM is undoubtedly rearing conditions. It is well known that the live weight of broiler chickens and turkey increased by more than two times over the last 50 years mainly due to the size of pectoral muscles (Semenova et al., 2019). An increase in incidence of DPM is connected with the increase in growth rate and muscle size. Petracci and Cavani (2012) came to the conclusion that the main problems related to occurrence of DPM in broilers are related to the selection of the chickens for growth rate and breast yield. It is known that heavier turkeys and broiler chickens have a higher incidence of this disease. Pajohi-Alamoti et al. (2016) found a significant link between chicken's age, weight and occurrence of the disease. Furthermore, broiler chickens are mostly inactive during the growing period in commercial farming conditions. The consequence is that the breast muscles are not active enough and therefore they cannot expand due to the lack of physical activity. Consequently, some rapid and immoderate wing activity could lead to degeneration and death of the cells in muscle tissue. Discoloration of the flesh is caused by swelling and represents a result of deficiency of oxygen in the breast muscle due to improper blood supply. Distinctive swollen reddish-brown lesions appear first and they are followed by lesion changes in color to green. Eventually, the lesions become pale green (Stangierski et al., 2019). Earlier findings showed that pathological changes affect both major and minor pectoral muscles (Pastuszczak et al., 2002).

Mechanical stresses which could occur during contracting of myofibers and inadequate energy metabolism are listed as the cause of muscular degeneration. Some other chicken breast meat abnormalities such as spaghetti meat, white-striping and wooden breast are also associated with intensive broiler production conditions as a result of pushing biological boundaries (Petracci et al., 2019).

It is very interesting that DPM was observed in free-range broiler chickens. Bilgili and Hess (2002) reported that DPM was more frequently found in males than in females. However, Lien et al. (2012) reported that DPM was more frequently found in females. Bianchi et al (2006) concluded that genetics plays an important role in the development of this condition.

Incidence and intensity of DPM

Kijowski et al. (2014) reported that the number of cases of DPM in commercial genetic lines increased in the USA, Italy, Greece and Bulgaria. In Poland, the number of cases in broilers aged five to seven weeks was in the range from 0.02 to 1.9% (Kijowski et al., 2014). Bianchi et al. (2006) noted that DPM was estimated to be below 1%. One case was reported in Romania in a household reared broiler chicken (Stancu et al., 2015). Pajohi-Alamoti et al. (2016) reported that 0.033% carcasses in slaughtered broiler chickens from the west of Iran were affected with DPM. In Bulgaria, Dinev and Kanakov (2011) reported 0.51% of carcasses with DPM.

Only one study related to DPM has been conducted in Serbia so far, at a slaughterhouse for fattening chickens from intensive housing conditions (Maslić-Strižak et al., 2014). The incidence did not depend on sex and in the examined hybrids it was 0.36% and 0.60%. No research has been conducted on the prevalence of DPM in chicken carcasses on the market.

Effects of DPM on poultry meat quality

The nutritional quality is the main reason for the fact that chicken meat is appealing to consumers worldwide, so the measures to preserve the quality of chicken meat are very important. The most significant quality attributes for poultry meat are appearance and texture (Giampietro-Ganeco et al., 2022). Meat color is important for consumers when they decide to buy raw meat in the marketplace. Meat texture is also very important when choosing poultry meat. Dransfield and Sosnicki (1999) reported that toughness and poor cohesiveness, color and water holding capacity are the main meat quality problems connected with the selection for muscle growth.

Pastuszczyk-Frak and Uradziński (2009) examined the hygienic and technological value of turkey meat originating from flocks with DPM and concluded that the meat was suitable for consumption from microbiological viewpoint. However, the technological value of the affected meat was diminished. Deviations in pH value, water binding capacity, color and chemical composi-

tion were observed. They reported that the meat affected with the DPM shows significant differences in cross-section color, juiciness and taste after thermal processing.

Cavalcanti et al. (2021) concluded that the severe condition of DPM causes variation in the quality of turkey muscle. They observed color changes in affected meat samples. Also, they observed a greater water-holding capacity, pH, length of sarcomere, fat content and lower shear force and moisture content in the affected samples in comparison to nonaffected samples. This is significant from the viewpoint of the manufacturing of processed products since fat content and water holding capacity represent crucial meat properties. They suggest that the processing represents a proper alternative for exploitation of affected meat. DPM affects the color and partially a reduction of texture of the breast meat which are the main attributes for consumers and chicken's most valuable part, which consequently has a negative economic impact on broiler meat industry (Giampietro-Ganeco et al., 2022).

Cavalcanti et al. (2021) concluded that the processing is an economically feasible potential for the commercialization of affected breast meat.

Consumers' acceptability of DPM

The main problem (with DPM) is the absence of symptoms (while chickens are) on the farm. It can be identified only during carcass dissection. The additional problem occurs when whole chickens are sold. The consumers normally detect the changes when cutting the chickens into pieces. They observe changes in color and texture of the muscles. Consumers recognize the observed changes as signs of spoilage. The main problem could be the fact that consumers will no longer trust the producer and they will refrain from buying chickens and other products in the future (Kijowski et al., 2014).

Consumers' attitude towards green muscle diseases should be regarded as an important and relevant issue. They have the right to know and choose what they want to eat. Consumers identify these changes as uncommon for chicken meat. The changes reduce the visual acceptability of chicken breasts and even the whole carcass. Unpleasant green color which appears when the chickens are cut scares the consumers despite the fact that meat is safe for consumption. De Carvalho et al. (2020) noted that the consumption of fresh poultry meat in some European countries decreased. The image of modern poultry farming system and a changed perception of poultry meat quality and safety are the important reasons for the above-mentioned decreasing trend in poultry meat consumption. The recognition of DPM may have negatively affected the consumer's attitude by associating the green muscle diseases with unhealthy and unsafe meat.

In the future, these conditions could lead to an increasing number of consumer complaints mainly due to the fact that it is regarded as an unpleasant “surprise” during preparation. The affected meat is unfit for consumption, it is sensory – organoleptic unacceptable.

Preventive measures and detection of DPM

The main problem is the fact that DPM is usually undetected until processing. Also, it is very difficult to predict the occurrence of this condition. DPM leads to significant economic losses due to the fact that it affects chicken breast which is the most valuable part of the carcass. During processing of chickens, the affected muscle tissue is removed.

Management practice on the farm is the most important preventive measure against DPM. Minimizing wing-flapping is the best preventive measure. It is very important to monitor health conditions of chickens, ventilation, air quality, ammonia level, temperature, etc. Also, the time that people spend in broiler farm should be limited. Noise levels and amount of light that could frighten the chickens should be minimized.

Recently, creatine kinase was identified as a blood enzyme that could be a noninvasive tool for breeders to screen birds for susceptibility to the disease. However, this method is not applicable in commercial poultry farms due to the time needed for analysis and high costs (Kijowski et al., 2014). Also, genetic selection against DPM could be an effective tool for reducing the future occurrence of DPM (Petracci et al., 2015). Petracci and Cavani (2012) reported that genetic selection against DPM has been undertaken by poultry companies. They also reported that developments in whole-genome selection using dense DNA - markers could be significant in reducing the occurrence of this disease in the future.

A non-destructive sensor able to detect DPM in whole carcasses has been developed (Traffano-Schiffo et al., 2018). The sensor measures the permittivity of chicken whole carcass with skin in depth. This method could be commercially available in future.

The presented data are very important for consumers, poultry farmers, poultry abattoirs, poultry suppliers, veterinary practitioners, inspectors and scientific community. There are no clinical signs of DPM and it could be detected only after dissection of carcasses. The diagnosis is confirmed by macroscopic examination. The main problem is the fact that this condition is only noticed after the broilers are slaughtered. DPM has important effect on meat quality. Such meat is aesthetically undesirable so the changed parts of meat should be removed and the rest of carcass is fit for human consumption. The

fact that DPM affects the most valuable parts of poultry carcass leads to significant economic losses.

This the only case of DPM which has been reported and confirmed in the laboratory for microbiological and sensory analysis of food of the Scientific Veterinary Institute "Novi Sad" so far. Due to the extreme concern of consumers, we considered it important to describe this case and draw attention to this disease. The presented data is of public interest and it could significantly contribute to the consumers' knowledge about the disease.

A proper solution to this disease is not currently commercially available.

ACKNOWLEDGEMENT

This work was funded by Ministry of Education, Science and Technological development of Republic of Serbia by the Contract of implementation and funding of research work of NIV-NS in 2022, Contract No: 451-03-68/2022-14/200031.

Author's Contribution:

DLJP and MP made substantial contributions to basic idea, conception and design, acquisition of samples and data, analysis of the data and interpretation of results; JV, BP, NN and SVK were involved in drafting of the manuscript, revising it critically for important intellectual content, and DLJP and MŽB gave the final approval of the manuscript to be published.

Competing interest

The authors declare that they have no competing interests.

REFERENCES

1. Bianchi M., Petracci M., Franchini A., Cavani C. 2006. The occurrence of deep pectoral myopathy in roaster chickens. *Poultry Science*, 85, 1843–1846. doi: 10.1093/ps/85.10.1843.
2. Bilgili S.F. and Hess J.B. 2002. Green muscle disease in broilers increasing. *World Poultry*, 18, 4, 42-43. doi:10.1093/ps/85.10.1843.
3. Cavalcanti É.N.F., Giampietro-Ganeco A., Mello J.L., Fidelis H.A., Oliveira R.F., Pereira M.R., Villegas-Cayllahua E.A., Souza R.A., Souza P.A., Borba, H. 2021. Breast meat quality of turkey breeder hens at disposal age affected by deep pectoral myopathy. *Poultry Science*, 101259. doi:10.1016/j.psj.2021.101259.

4. De Carvalho L.M., Ventanas S., Olegario L.S., Madruga M.S., Estévez, M. 2020. Consumers awareness of white-stripping as a chicken breast myopathy affects their purchasing decision and emotional responses. *LWT*, 131, 109809. doi: 10.1016/j.lwt.2020.109809.
5. Dickinson E.M., Stephens J.O., Helfer D.H. 1968. A degenerative myopathy in turkeys. In *Proceedings*, 17th. Western Disease Conference, University of California, Davis, USA, 7.
6. Dinev I., Kanakov D. 2011. Deep pectoral myopathy: prevalence in 7 weeks old broiler chickens in Bulgaria. *Revue de Médecine Vétérinaire*, 162, 279–283.
7. Dransfield E. and Sosnicki, A.A. 1999. Relationship between muscle growth and poultry meat quality. *Poultry science*, 78, 5, 743-746. doi: 10.1093/ps/78.5.743.
8. Giampietro-Ganeco A., de Almeida Fidelis H., Cavalcanti E.N., Mello J.L.M., Borba H., de Souza R.A., Carvalho L.T., de Souza P.A., Trindade M.A., 2022. Research Note: Quality parameters of turkey hens breast fillets detected in processing plant with deep pectoral myopathy and white striping anomaly. *Poultry Science*, 101709. doi: 10.1016/j.psj.2022.101709.
9. Kijowski J., Kupińska E., Stangierski J., Tomaszewska-Gras J., Szablewski, T. 2014. Paradigm of deep pectoral myopathy in broiler chickens. *World's Poultry Science Journal*, 70, 1, 125-138. doi:10.1017/S0043933914000117.
10. Lien R.J., Bilgili S.F., Hess J.B., Joiner K.S. 2012. Induction of deep muscle myopathy in broiler chickens via encouraged wing flapping. *Journal of Applied Poultry Research*, 21, 556-562. doi:10.3382/japr.2011-00441.
11. Maslić-Strižak D., Spalević Lj., Stanojević-Momčilović V., Radosavljević V., Pavlović I. (2014). Zeleni mišić tovnih pilića. *Ecologica*, 21, 76, 741-744.
12. Pajohi-Alamoti M., Khaledian S., Mohammadi M., 2016. Study of green muscle disease in some condemned broiler chicken from Iran. *Comparative Clinical Pathology*, 25, 1193-1196. doi: 10.1007/s00580-016-2327-9.
13. Pastuszczak-Frak M. and Uradziński J., 2009. Hygienic and technological value of meat of turkey raw meat originating from flocks with green muscle disease. *Polish Journal of Veterinary Sciences*, 12, 2, 243-250.
14. Pastuszczak M., Uradziński J., Rotkiewicz T. 2002. Histopathological changes in green muscle disease of turkeys. *Polish Journal of Veterinary Science*, 5, 2, 63-70.
15. Petracci M. and Cavani, C., 2012. Muscle growth and poultry meat quality issues. *Nutrients*, 4,1, 1-12. doi: 10.3390/nu4010001.
16. Petracci M., Mudalal S., Soglia F., Cavani C. 2015. Meat quality in fast growing broiler chickens. *World's Poultry Science Journal*, 71, 363-374. doi: 10.1017/S0043933915000367.

17. Petracci M., Soglia F., Madruga M., Carvalho L., Ida E., Estévez M. 2019. Wooden-breast, white striping, and spaghetti meat: causes, consequences and consumer perception of emerging broiler meat abnormalities. *Comprehensive Reviews in Food Science and Food Safety*, 18, 2, 565-583. doi: 10.1111/1541-4337.12431.
18. Richardson J.A., Burgener J., Winterfield R.W., Dhillon A.S. 1980. Deep pectoral myopathy in seven-week-old broiler chickens. *Avian Diseases*, 24, 1054-1059. doi: 10.2307/1589983.
19. Semenova A.A., Kuznetsova T.G., Nasonova V.V., Nekrasov R.V., Bogolyubova N.V. 2019. Myopathy as a destabilizing factor of meat quality formation. *Theory and practice of meat processing*, 4, 3, 24-31. doi: 10.21323/2414-438X-2019-4-3-24-31.
20. Stancu A., Olariu-Jurca I., Olariu-Jurca A., Claudia Sala A.M., Pentea M., Imre K., 2015. Deep pectoral myopathy (Green muscle disease) in a household reared and slaughtered broiler chicken-A case study. *Lucrari Stiintifice: Medicina Veterinara Timisoara*, 48, 1, 183-187.
21. Stangierski J., Tomaszewska-Gras J., Baranowska H.M., Krzywdzińska-Bartkowiak M., Konieczny P. 2019. The effect of deep pectoral myopathy on the properties of broiler chicken muscles characterised by selected instrumental techniques. *European Food Research and Technology*, 245, 2, 459-467. doi: 10.1007/s00217-018-3177-2.
22. Traffano-Schiffo M.V., Castro-Giraldez M., Herrero V., Colom R.J., Fito P.J. 2018. Development of a non-destructive detection system of Deep Pectoral Myopathy in poultry by dielectric spectroscopy. *Journal of Food Engineering*, 237, 137-145. doi: 10.1016/j.jfoodeng.2018.05.023.
23. Yalcin S., Ozkan S., Acar M.C., Meral O. 2018. The occurrence of deep pectoral myopathy in broilers and associated changes in breast meat quality. *British poultry science*, 59, 1, 55-62. doi:10.1080/00071668.2017.1401214.

Received: 01.03.2022.

Accepted: 30.05.2022.