UNIVERSITY OF KRAGUJEVAC

FACULTY OF AGRONOMY ČAČAK

# SYMBIOTECH

## 2nd INTERNATIONAL SYMPOSIUM ON BIOTECHNOLOGY

14–15 March 2024

Faculty of Agronomy in Čačak, University of Kragujevac, Serbia

## - PROCEEDINGS -

# 2nd INTERNATIONAL SYMPOSIUM ON BIOTECHNOLOGY

XXIX Savetovanje o biotehnologiji sa međunarodnim učešćem

## - PROCEEDINGS -


## ORGANIZER AND PUBLISHER

**University of Kragujevac, Serbia**
**Faculty of Agronomy in Čačak**

## Honorary Committee

Prof. Dr. Marina Pintar, Slovenia; Prof. Dr. Andrej Bončina, Slovenia; Prof. Dr. Branko Kramberger, Slovenia; Prof. Dr. Tomaž Langerholc, Slovenia; Prof. Dr. Ivica Kisić, Croatia; Dr. Kristina Kljak, Croatia; Prof. Dr. Krunoslav Zmaić, Croatia; Prof. Dr. Zvonko Antunović, Croatia; Prof. Dr. Muhamed Brka, B&H; Prof. Dr. Enisa Omanović-Mikličanin, B&H; Prof. Dr. Ivan Ostojić, B&H; Dr. Adrijana Filipović, B&H; Prof. Dr. Božidarka Marković, Montenegro; Prof. Dr. Sanja Radonjić, Montenegro; Prof. Dr. Vjekoslav Tanaskovik, North Macedonia; Prof. Dr. Ivana Janeska-Stamenkoska, North Macedonia; Prof. Dr. Zlatan Kovačević, B&H; Prof. Dr. Željko Vaško, B&H; Prof. Dr. Dragutin Đukić, Serbia; Prof. Dr. Nedeljko Tica, Serbia; Prof. Dr. Branko Ćupina, Serbia; Prof. Dr. Dušan Živković, Serbia; Prof. Dr. Vladan Bogdanović, Serbia; Dr. Darko Jevremović, Serbia; Dr. Marijana Pešaković, Serbia; Prof. Dr. Cosmin Salasan, Romania;

## Technical editors

Prof. Dr Vladimir Kurćubić; Prof. Dr Pavle Mašković; Dr Marija Gavrilović; Dušan Marković, BSc

**Print-run: 30**

**Printed by**
MEDIGRAF - Čačak, Aleksandra Savića 42, 32000 Čačak

ISBN 978-86-87611-91-7

**Year of publication: 2024**

DOI: 10.46793/SBT29.28MP



# REARING SYSTEMS AND PRODUCTION IN ORGANIC POULTRY FARMING

*Milun D. Petrović[1], Snežana Bogosavljević-Bošković[1], Vladan Bogdanović[2], Radojica Đoković[1], Simeon Rakonjac[1], Miloš Petrović[1]*

**Abstract:** Poultry farming on free-range can be organized in various ways, depending on the type and characteristics of facilities and outdoor areas. Generally, these rearing systems can be categorized into a fixed facility free-range system and a mobile facility free-range system (structures on wheels). In organic poultry production, two organic production systems are prevalent: organic egg production and organic meat production.

**Keywords**: organic poultry production, organic meat, organic eggs.

## Introduction

The production of a sufficient quantity of healthy food for the growing global population is one of the most crucial issues for the survival of modern society. One of the earliest predictions of a bleak future on this topic was made by Professor Jon Bedington when he proposed in his paper that the world's population would require a 50% increase in food production by the year 2030 (Bedington, 2009). The significance of food for individuals and society as a whole was explained by the renowned sociologist Abraham Maslow, the creator of the "hierarchy of needs." He emphasized that the need for food is a fundamental human requirement and that it is essential to satisfy this need before addressing all other needs (Maslow, 1954). Environmental conservation and intensive agriculture are not compatible, which is why organic farming has been recognized as an important solution to address these significant global issues.

With the realization of the negative effects of intensive industrial agricultural production as well as the consequences that consumption of products from the same can have from the aspect of consumer health (Laurence, 1991; Passille, 1997), interest in unconventional, especially organic, production is growing. All this has influenced that during the last decade, the volume of organic production on a global scale has increased significantly. Standards defined through laws and

[1]University of Kragujevac, Faculty of Agronomy Čačak, Cara Dušana 34, Čačak, Republic of Serbia (milunp@kg.ac.rs);
[2]University of Belgrade, Faculty of Agriculture in Belgrade, Nemanjina 6, Republic of Serbia

regulations that provide a framework for enabling good living conditions for domestic animals also contributed to the spread of organic production. These minimum standards, however, are not necessarily a guarantee for good conditions in terms of animal welfare and health (Sundrum, 2001; Kijstra and Eijck, 2006).

Organic agriculture is a management system that strives for ecologically and ethically acceptable, health-safe, socially just and economically profitable agricultural production (Petrović et al., 2020 and 2022). It is not only the production of high-value food and other agricultural products, but also implies a specific and high-quality relationship with natural resources, their use in meeting food needs, as well as the economic profitability and sustainability of production (Pavlović et al., 2011; Nikolić et al., 2013).

## Rearing systems in organic poultry production

One of the fundamental characteristics of rearing systems in organic poultry production, whether it is organic egg or meat production, is the presence of outdoor access that primarily allows the natural behavior of poultry to be fully expressed. Poultry can move freely, enjoy fresh air and sunlight, and be reared for a sufficient duration, imparting a distinct quality to their products. On the other hand, having outdoor access is technologically more demanding compared to rearing poultry within buildings, mainly due to losses from diseases and predators. Additionally, outdoor production is seasonal because weather conditions significantly influence yield and product quality.

Rearing poultry with outdoor access can be organized in various ways, depending on the type and characteristics of facilities and outdoor areas. In general, these rearing systems can be categorized into:

- Fixed Facility Free-Range System
- Mobile Facility Free-Range System (Structures on Wheels).

These systems provide different approaches to organic poultry rearing, each with its advantages and challenges, contributing to the overall goal of sustainable and humane poultry production.

It implies an object of solid construction around which there is an outlet. The advantages are that you can build a solid building with water and electricity, so that you can also provide heating during the rearing of chickens. Poultry have access to the outlet located around the facility, and spend the night inside.

The disadvantage is that the poultry damages and destroys the vegetation on the outlet, so it is destroyed very quickly if rotation is not ensured, i.e.

moving the poultry from one part of the pasture to another. If an extraction system is not provided, the discharge turns into mud very quickly, especially in the area immediately around the facility, so the appearance both of dirty eggs and the risk of disease increases.

Providing access to open areas and allowing poultry to roam "outside" the enclosure of buildings allows them to express their natural behavior. They can freely roam, scratch, peck, dust bath, feed and supplement their diet on the outlet. Direct exposure to sunlight helps prevent disease. Overall, outdoor access contributes significantly to improving poultry welfare, but only if it is properly designed, has adequate space and is well maintained. Otherwise, it can present challenges for both birds and for production.

The outlet must be covered with vegetation. It is preferable to have trees inside the outlet or at least along its edges, which provide shade for the hens to avoid excessive sunlight. The soil must have sufficient drainage to prevent water retention and mud build-up. Food and water must be provided to poultry outdoors, reducing the need for constant entry into facilities.

Feeders should be covered from above to prevent wild or flying birds from reaching them. Covering the feeders also protects them from the rain. The water must always be clean and fresh. Both feeders and waterers should be mobile, allowing them to move around the open space.

If the outlets are without vegetation and trees, i.e. represent a "cleared space", it is necessary to build canopies at the outlet as well, because they provide protection to birds from predators and weather conditions - primarily sun and rain. Without them, the poultry would feel uncomfortable because they do not like to be exposed to flying predators. Also, birds do not like strong sun and wind, so some protection is necessary for them. Some researches have shown that the poultry has no problem to "pluck" and move around in the open space, but prefers to rest in some bushes or among the branches.

Research in Great Britain has shown that in large flocks reared in the "free range" system, only 15% of the birds from the flock are outside, while the rest are inside the facility. If the outlet was better covered by trees, the number of poultry at the outlet is higher. The use of the outlet depends on the time of year (in the spring it is used more than in the winter), as well as on the time of day (the hens leave the least at noon). In order to motivate the poultry to move away from the buildings and use the entire outlet, it is necessary to place the feeders and shelters a little further from the building. Some birds that are extremely active move even 100 m away from the building.

Since birds are reluctant to leave the facility, it is necessary to encourage their exit and movement, and this can be achieved by building and designing the facility. The buildings should be small, and the openings for the exit of the poultry should be relatively large and wide. There should be a sufficient number of openings for exiting the building (4 m per 100m$^2$) so that the poultry do not pile up on the openings and that several of them could enter and leave the building at once. This is very important with outlets, because when the birds sense danger, they must be able to quickly fly into the facility and seek protection, without the risk of getting stuck.

Another factor that depends on the degree of use of the outlet is the reared genotype. Broiler chickens, which are not usually used in organic production, are much heavier and reluctant to move. Much more active are slow-growing hybrids for meat production, light hybrids for egg production and combined breeds of chickens. During the day, they like to go out to bars and rummage in search of food, and at night they enter buildings and spend the night there. They mostly do this instinctively, although some chickens have to be taught to enter the facility on their own at night.

Part of the nutrients are taken in by the birds through grazing, and part by digesting insects and earthworms, thus obtaining high-quality animal proteins. They can use the plant part relatively poorly because chickens, although they have two caecums, do not digest cellulose (5-8%), so it is basically difficult to estimate how many nutrients are actually taken into the body on pasture. According to some estimates, pastures can replace 5-10% of the feed, but most experts advise not to count the contribution of pastures to the diet, but to balance nutrients as if complete needs are met by food.

The maintenance of the outlet is a key moment in the system of organic production of meat and eggs on the outlet. The vegetation must be maintained, and it is preferable that the plants are young, in the early phase of the vegetation, because otherwise the poultry will not consume them, they will just trample on them. If the grass is too tall, the poultry make tunnels through the tall grass and pass through them just to get to the feeder, and the rest of the outlet is not used at all. Tall grass, on the other hand, is often wet, so it is suitable for the development of parasites. The moisture from the grass will also wet the feathers of the poultry, so they will bring that moisture into the building, which is not good because it will stain the mat.

Outlet rotation allows the pasture to rest, the vegetation to recover from trampling, and to prevent the build-up of manure material and the development of pathogens. Outlet should be rotated for a minimum of two to

three months, although a month would be best. With broilers, the outlet can be rotated after each turn (after the birds are sold and delivered), but it cannot remain on the same outlet during the entire production period. Rotation is most easily done by dividing the outlet into 4 parts, so the birds move from one part to another after a while. In America, the Soil Association recommends that the outlet be rested for 12 months between flocks, with a minimum of 9 months. This means that if the outlet is divided into 4 parts, the poultry can stay in each part for 3 months, and then move to another part. In this way, each part is in use for 3 months and rests for 9 months.

The problem with non-rotating outlet is that the vegetation is completely destroyed, and the substrate turns into mud and dirt. This is introduced into buildings and nests and the eggs are contaminated. Also, pathogenic microorganisms multiply on such a outlet, so the risk of disease increases. If less than 50 hens are reared, outlet rotation is usually not necessary.

The system with movable objects on the outlet enables their movement, which enables the even use of the entire grass area and the preservation of the outlet. Mobile homes always have a smaller capacity because they have to be moved regularly. They can be quite simple - in the form of a canopy with a wooden structure or a very solid closed house. They are mostly on wheels, so they can be moved with the help of a tractor or an all-terrain vehicle. Moving is done every few days depending on the plan of using the outlet. The houses must be moved at least once a week because after that the plants can be permanently destroyed. It is estimated that it takes about a month for the outlet to recover, but it primarily depends on the climatic conditions. It is important to make a good shift plan so that one part of the pasture is used and the other parts are rested and regenerated.

If the houses are not on wheels, it is more difficult to move them, although they can also lean and move to another part of the pasture. Those houses should be of very light construction, more reminiscent of canopies, so that they can be easily moved to another part of the outlet.

**Rearing systems in organic poultry production**

There are two systems of organic poultry production:

- ***organic egg production***
- ***organic meat production.***

Unlike conventional production, these two systems are not clearly separated, but are usually integral and complement each other.

In the production of organic eggs, it is similar to the free range system, with the fact that the producers must comply with the Rulebook of Control and Certification of Organic Production and methods of Organic Production (2021), according to which food must also come from organic production, with the prohibition of the use of additives, colors and medicines. In essence, the system for organic egg production is regulated by law with restrictions related to the capacity and technological norms in the construction of facilities and, above all, to the nutrition and treatment of laying hens. Poultry farms that produce eggs in this way are specially registered, regularly controlled by the inspection of the competent state authority and must keep the prescribed records. During egg production in an organic system, layers should have constant access during the day to an open outlet that is covered with vegetation and whose maximum population is 580 layers per hectare, i.e. minimum 4 $m^2$ per hen (Rulebook of Control and Certification of Organic Production and methods of Organic Production, 2021). Feeders and drinkers are placed at the outlet.

In organic production, laying eggs usually remain in production for a second year, after the moulting period. In the second year, the laying capacity is lower, but larger eggs were layed. Namely, the production of organic eggs usually starts at the age of the flock between 12 and 14 weeks of age. Until that age, the flock was reared under similar conditions as in conventional (intensive) production. From the 14th to the 20th week, there is a preparatory period, and at 20 weeks of age, laying hens start producing eggs (Lampkin, 1997). The maximum production rate (95%) is achieved at 28 weeks of age, while production intensity until the end of the production cycle (up to the 72nd week of age, i.e. 52 weeks of egg production) ranges between 60% and 65%.

From a nutritional perspective, it is ideal to produce as much of the total feed requirement as possible on one's own farm. This represents the most favorable solution in terms of reducing the cost of purchasing animal feed and is harmonized with the dominant characteristic of organic poultry production. Some calculations show that if all the nutrients in the diet are produced on the farm, with 1 hectare of arable land, the needs of about 100 laying hens can be satisfy (Hörning, 1995). Basically, the nutrition of laying hens is organized in such a way that they are provided with a complete mixture of food in the barn, and additional nutrition (grains, semolina, green fodder) is provided in the open area. External access allows poultry access to additional food sources in addition to the food provided by the farmer (Gordon and Charles, 2002).

In an organic meat production system, broilers are usually kept indoors on litter until 28 days of age (maximum 11 chickens/$m^2$) and fed standard diets

with 21.5 to 23.0% crude protein, i.e. 3,050 to 3,080 kcalME/ kg. After this age until the end of the growing period (minimum 81 days), chickens should have access to grassy open areas (minimum 4 $m^2$/chicken), and different grains can be used, primarily corn, oats, wheat and certain varieties of triticale. serve as the main food. Poultry in open spaces also benefit from supplementary feed such as green feed, seeds, insects, worms, etc. This approach not only provides a significant amount of high-quality protein, but also provides the necessary amounts of vitamins and minerals, which significantly improves the quality of the meat. Van de Weerd et al. (2009) point out that outdoor access stimulates locomotion, leading to stronger leg muscles, yellower meat, higher proportion of breast and thigh meat and lower abdominal fat content in organically raeared broilers. In addition, a better sensory quality of the breast muscle was observe.

## Conclusion

Growing awareness of ecosystem disruptions and the overall threat to biodiversity has required a re-examination of the technologies and methods used to accelerate production growth in all human activities, including agriculture. Despite the fact that a large number of individuals of different types of domestic animals are bred all over the world and in our country, there is an increasing objective danger of their rapid disappearance due to the decline of adaptive abilities.

The advantage of organic production of meat and eggs in poultry farming is that this kind of production enables mitigating the negative effects of social development on the ecosphere and the human population as a whole. Organic production of meat and eggs can cover all the above-mentioned requirements regarding the preservation and well-being of the environment in the rearing of different types and categories of poultry, with realistic possibilities of development in our conditions. It is necessary to mention that one of the most significant characteristics of organic poultry farming is the unity of plant and animal production.

Based on the above, it can be concluded that areas with natural potential, opportunities for sustainable development and environmental protection should be sought as development opportunities for underdeveloped countries. For Serbia, the concept of organic poultry farming represents just such an opportunity.

## Acknowledgements

This work is part of the research project 451-03-66/2024-03/200088 funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia.

## References

Bedington J.(2009). Food, energy, water and the climate: A perfect Storm of Global Events? www.bis.gov.uk/assets/geoscience/docs/p/ perfect-storm=paper.pdf.

Gordon S.H., Charles D.R. (2002). Niche and organic chicken products; their technology and scientific principles. Nottinham University press.

Hörning B. (1995). Geflügelhaltung im öhologischen landban. In: Ogologische Geflügelhaltung. BAT/GhK, Fachgebiet Nutztierthologie; Witzenhausen, 7-15.

Kijlstra A., Eijck I.A.J.M. (2006). Animal health in organic livestock production systems; a review. NJAS Wageningen Journal of live Sciences, 54 (1), 77-94.

Lampkin N.H. (1997). Organic Poultry Production. Final report to MAFF, University of Wales.

Laurence E. A. (1991). Relevance of social science to Veterinary Medicine. Journal of American Medical Association, 199, 1018-1020.

Maslow Abraham (1954). Motivation and Personality. New York: Harper.

Nikolić O., Jovanović Lj., Jelić M., Milovanović M., Pavlović M. (2013). Variability of Serbian winter wheat genotypes and their evaluation in terms of sustainable agriculture. The Journal agriculture and forestry, 58 (2), 19-26.

Passille de A.M.B. (1997). Le lait ecologique fait son nid. Le Bulletin des Agriculteurs, 3, 51-54.

Pavlović M., Nikolić O., Jovanović Lj. (2011). Strna žita u funkciji organskog stočarstva. Ecologica, 18 (64), 671-676.

Petrović D.M., Bogosavljević-Bošković S., Rakonjac S., Đoković R., Dosković V., Petrović M., Veljković B. (2020). Sistemi gajenja i proizvodnje u organskom govedarstvu. Zbornik radova, XXV Savetovanje o biotehnologiji sa međunarodnim učešćem, 309-314, 13-14. mart 2020, Čačak, Srbija.

Petrović D.M., Bogosavljević-Bošković S., Bogdanović V., Đoković R., Rakonjac S., Petrović M. (2022). Sistemi gajenja i proizvodnje u organskom svinjarstvu. Zbornik radova, XXVII Savetovanje o biotehnologiji sa međunarodnim učešćem, 257-262, 25-26. mart 2022, Čačak, Srbija.

Rulebook of Control and Certification of Organic Production and methods of Organic Production (2021). The Official Gazette of Republic of Serbia, No. 95/20 and 24/21.

Sundrum A. (2001). Organic livestock farming A critical review. Livestock Production Science, 67, 207-215.

Van de Weerd H.A., Keatinge R., Rodericks S. (2009). A review of key health related welfare issues in organic poultry production. World's Poultry Science Journal, 65, 649-684.