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Complex Self-Sustainable Technical System for Producing Meat Products and Eggs and Its Multiplied Benefits

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Abstract

Examined several parameters during operation and production, including parameters of operation of a biogas plant, parameters during biogas production, and parameters during operation of a meat industry. Researches, trails and tests were done in order to emphasize the multiple benefits of the operation of the complex self-sustaining technical system for the production of meat and meat products. That system includes several smaller subsystems, closely related to each other which, according to the researches, represent a perfectly functional unit that results in the production of high-quality meat products, but also eggs and electricity from the waste materials of those two subsystems. The production of electricity in the part of this complex system, even better known as green or bioenergy, with the conducted tests shows that it does not affect at the quality of the products in the slightest, also its production does not affect the pollution of the environment or the products themselves.The results obtained from numerous researches and tests are fully in support of proving that multiplied benefits are a positive result of the operation of a complex self-sustaining technical system for the production of meat products.Every modern society should have at least one such system for food production, and in parallel with that, production of electrical (bio) energy with zero pollution, for healthy environment which reproduces healthy population.

Keywords: biofuel - biogas, bioenergy, consumer eggs, hens..

1. Introduction

Studying aspects of environmental conservation greatly help living as well as maintaining and preserving health. A healthy environment means an environment with a low rate of pollution, an environment dominated by attention and dedication, because attention directed to it means attention directed to ourselves, for the simple reason that we live, breathe and feed on it. The biggest polluters nowadays are necessary for all of us, because they themselves create our needs, where the main representative is electricity, which we obtain to the greatest extent by processing coal in mining plants, and as a negative (by-product) of all that is the huge pollution that is the result of its production. But, like everything else nowadays, that way of producing electricity is replaceable, with appropriate ecological, i.e. renewable energy sources. Biogas is one of the most exploited renewable energy sources and can play an important role in the functioning of modern waste management systems. (Lindkvist, 2020) For renewable energy sources, there are legal regulations of the European Union that contain certain directives, the most important is Directive 2001/77/EC (OJ L 283, 27.10.2001) of the European Parliament and of the Council on the promotion of electricity produced from renewable sources of energy in the internal market. The directive defines the origin of the producer of electricity from renewable sources. In our country, there is a legal regulation for the promotion and utilization of renewable energy sources. At the level of the European Union, the share of electricity from renewable sources was 25.4% in 2019, of which the largest contribution with 42% is hydropower, 26% wind energy and 12% biomass. When it comes to the term "biomass" - it is the biodegradable part of products, waste and residues from agriculture (including plant and animal substances), forestry and related industries, as well as the biodegradable part of industrial and municipal waste. The main advantage of using biomass as a source of energy is the abundant potential, not only in terms of planted crops, but also in waste materials in agriculture and the food industry. The gases produced by the use of biomass can also be used in energy production. The advantage of biomass compared to fossil fuels is an incomparably lower emission of harmful gases and waste material . Biogas is created when organic material decomposes in an anaerobic environment in the presence of microorganisms. The decomposition process is called anaerobic digestion and it takes place naturally in many environments with a limited presence of oxygen, such as: in ponds and swamps, in rice fields, but also in the stomachs of ruminants. This natural process can be used in biogas plants where organic material is fed. The basic part of the plant is a closed chamber or a

hermetically sealed container (often called a reactor - digester) in which the digestion reaction takes place. The end product of decomposition is a combustible gas called biogas and an organic residue in the digester that contains minerals and is suitable for use as liquid or solid bio-fertilizer.

2. **Material and Metods**

Technical system for the production of high quality meat processing. The main food for human nutrition is actually meat. The term meat in the broadest sense of the word means all the parts that are eaten from animals for slaughter, which include the skeletal muscles with their associated tissues, the internal organs that are eaten and the blood. More narrowly defined, the term meat is the muscle tissue with associated bones, cartilages, rough connective tissue and fat deposits. This term is most often used for meat in trade, when it is in the form of a processed carcass, while a narrower term meat is defined as muscle tissue with its associated connective fat tissue, including a small amount of epithelial nerve tissue, from which the trimmings have been removed, cartilaginous, rough connective tissue, as well as larger deposits of superficial fatty tissue, so this term refers to "tender" meat. Meat provides the necessary nutrients and building materials for all ages in the population. At the same time, it is important to highlight the fact that meat is a rather sensitive food that is highly susceptible to rapid spoilage if all the necessary hygienic conditions are not provided in the rearing of animals, their transport, preparation for slaughter, especially during the procedure itself of slaughtering and primary processing, and also if good work and hygiene practices are not observed, as well as during the turnover and preparation for consumption of the meat. In addition, the quality of meat as a foodstuff depends on numerous factors, including: breed, sex, the way the animals are fed, as well as the course of procedures during the slaughtering and primary processing, the way it is cooled and the post-mortem processes. , as well as the ratio of individual tissues that make up the basic composition of the meat. (Y.H.Hui et al., 2012). Meat and meat processing are done under strictly controlled conditions, starting in the poultry reception area, where the type and condition of the meat is checked, as well as the organoleptic examination of the quality of the meat. The same is microbiologically checked before or at the end of processing or processing, then it is distributed for further operation, i.e. whether it will be used as raw meat and as such it will be placed on the market, will it be used as processed meat (deboned - cleaned chicken meat) or will it be used for further processing, then processing, in order to obtain processed meats such as salami, sausages, hot dogs, smoked meat products, baked and packaged meat for chicken gyro, sliced salami or brined chicken products etc. From the reception area, the meat as such continues to appropriate processing depending on what final product it will be prepared for, so after processing it continues to its packaging, storage or freezing of the same, if it is used as a raw final product. In case the meat will be used to obtain chicken products, the same continues in the further parts of the system for the production of meat products. As such, it can be boiled in suitable autoclaves, then chopped in suitable cutters, then by adding spices and additives, it can be packed in suitable packaging depending on which final product will be filled, whether it is salami, hot dogs, sausages etc. After finishing the filling and primary packaging of the processed chicken meat, it continues with its appropriate heat treatment at a certain temperature and humidity (depending on which end product is filled), after that treatment we already have a finished end product and it is cooled under a water shower , then it is left to stabilize at a certain temperature, and after reaching the required firmness, quality and temperature inside the finished chicken processing (measured with special probes), it is left at an appropriate temperature in warehouses until its delivery. The technical system for the production of meat processing, which is closely correlated with the technical system for the production of poultry meat and eggs and the technical system for the production of bioenergy from its own biogas, is at a great advantage because its production is carried out in a healthy and clean environment, despite the production of biogas because it does not have any pollution, and thereby further improves the quality of finished chicken products because they are created in a clean and ecologically healthy environment. In addition, in this system, the complete heating of the premises, as well as the use of hot water, is obtained completely from the production of bioenergy as a result of the combustion of biogas. The use of clean and free hot water in the production of chicken products reduces the costs of their production, and thus their final price becomes more competitive and more attractive for consumers on the market. The correct exploitation and coordination of these systems in a complex self-sustaining technical system results in multiplied benefits both from a financial and a qualitative aspect, resulting in products of higher quality than the competition, with a relatively lower cost and thus a more competitive final price. For the safety of the consumers, meat producing is exposed to full scrutiny and inspection. First of all the meat is inspected, then the producing area, also the final product is inspected for microbiological correctness (Salmonella spp., Listeria monocytogenes, Campylobacter spp., Yersinia enterocolitica and E. Coli 0157:H7).

Technical system for producing eggs and product of eggs. The egg is a female sex cell in multicellular animals and humans, from which a new individual develops, identical to fertilization. The egg

from birds and even domestic poultry is a very complex and highly differentiated reproductive cell whose structure is closely related to the function of maintaining life continuity. In addition, it is an almost complete source of vitamins and minerals essential for the human body, external and internal qualitative characteristics of eggs are very important for the health of consumers, but also from the perspective of marketing. The yield and quality of the egg is in direct correlation with numerous factors such as the genetics of the hen itself, the way they are housed, the temperature of the environment, nutrition[1]. By the very creation of the eggs by the hens, they are automatically collected, controlled and inspected. Initially physical, then their bacteriological correctness in certified laboratories. In fact due to our legal provisions, the absence of bacteria salmonella and listeria monocitogenes in 25 grams of must be tested.

Benefits of using the biogas production system as part of the complex technical system. The interconnection of these production technical systems, i.e. the connection of the system for raising chickens and egg production, in correlation with the technical system for the production of meat processing and the main link of this complex technical system, which is represented by the biogas production system, enables uninterrupted work, reduction of production costs of their products, protection of biodiversity, simplified way of working, reliability and accuracy in the planning and operation of such a complex self-sustaining technical system. The above-mentioned main link of the complex technical system – the biogas production system is such a system that has many benefits, and on the other hand, there are no or very few disadvantages. The biogas generally obtained from the waste materials of the part of the system in which the poultry is grown is composed to the greatest extent of methane and carbon dioxide. [2]Using a biogas production system requires an investment of funds, time and extensive professional preparation, and these are perhaps the only disadvantages, which are overcome in a very short period of time, and then only the benefits remain. The numerous positive aspects of this system are reflected in the fact that electricity is produced without the slightest negative impact on biodiversity, in parallel with that, the produced electricity is used for the operation of the entire technical system, for all the production capacities in that assembly, and a certain part is released into the electrical network for other users with appropriate compensation. The production of electricity is done at the expense of waste from other technical systems in such a complex technical system. The produced electricity is rightfully called bioenergy because it is obtained by burning methane, which is actually biogas, obtained by fermentation of waste materials from the poultry and egg production system. Fermentation is carried out in appropriate fermenters - digesters, where both dry and liquid substrate (waste substances and feces) are introduced with appropriate pumps and, under precisely determined conditions, biogas is created. The biogas thus created does not go anywhere else except in the biogas reactors – internal combustion engines that are part of the bioenergy production system, it burns without any pollution. The production of bioenergy by burning biogas is significant in terms of maintaining a safe and healthy environment, so the poultry uses unpolluted air, thereby giving microbiologically sound eggs of high quality, then obtaining healthy and clean meat that is used in meat processing industry from this complex technical system. Generally, the benefits of using such a complex self-sustaining technical system for the production of meat and meat products are multiplied and this is observed and monitored through the final results that are seen in quality meat products, quality meat processing, quality eggs, the preservation of the environment, the reduction of the production costs, and thus the final price of the products, constant and uninterrupted obtaining of electricity for own needs, but also for other consumers. A large number of the benefits, apart from financial ones, are in addition to the health of the people involved in the production process, the surrounding residents, as well as directly to the consumers, and this clearly speaks of the quality and the need for the creation of more biogas plants that will act independently or in correlation with other technical systems.

3. Results and discussion

The primary objective, together with the research carried out for the purposes of this manuscript, examines the functioning of a completely closed poultry farming system, primarily used for egg production and poultry meat processing, and secondarily used for the generation of biogas primarily for the production of electricity for the needs of the production capacity and the rest is released into the electricity network. That is, you determine whether optimal technological parameters for obtaining quality meat processing will be provided in such a closed circle of production. The results of measuring and monitoring the operation of the biogas plant are shown below on figure 1. From here you can see how the biogas plant works, how many Mwh of electricity it produces, compared to its maximum capacity, shown on a monthly basis throughout the year 2020. The needs of the entire technical system were met, part of the produced electricity was released into the system for other

[1] Y.H.Hui et al., 2012

[2] Wilkie, 2008

consumers, and all this was done without losses and interruptions in work. The continuous operation of the biogas plant ensures its correctness, timely servicing and the avoidance of work stoppages, but for it to be able to work, a fuel element is needed, in this case biogas, which is obtained from multiple sources, among which is corn silage, where it is noted that in the months with higher consumption of electricity, a larger amount of silage is used, which is directly proportional to the production of biogas and bioenergy. Despite the bioenergy producing, in this closed system are produced eggs, meat and meat products. There are many checking among which checking the presence of harmful substances in animal feed, i.e. feed for hens that lay eggs and are later used as the main source of meat in the processing capacity for meat products. It is shown in the following figure number 2, where it is clearly visible that in five examined samples of that food there is no presence of any harmful microorganisms or other substances that would later adversely affect the laid eggs or the quality of the meat of the examined poultry. In the following figure number 2, the five examined samples of the hen's food are taken in 28.01.2020 from five different plates for feeding the hens and the result is in the figure no.2. The presence of harmful microorganisms and bacteria in fresh consumer eggs as well as in meat from chickens has been determined to be non-existent by multiple tests. In the next figure number 3 are showed data on microbiological correctness of sample of finished product units from report no. 003820. The data shown in figure nubmer 3 for the microbiological correctness of one unit of the "smoked chicken fillet" sample are equal to the data for the other four units of the given sample, shown in the corresponding report, and this clearly shows the absence of unwanted microorganisms-bacteria that would lead to spoilage of the product, and in addition to a harmful effect on the health of consumers. This shows that the tested sample meets the requirements of the Rulebook on special requirements relating to microbiological criteria for food - Official Journal no. 100/13 Item 1.5. On the next figure number 4 are showed - Data on microbiological correctness of sample units chicken sausage "Seemiler"from report no. 0015520. From this figure we can see that there is not any presence of any harmful microorganisms or bacteria in finished products, which are produced in this closed and a complex self-sustainable technical system for producing meat and meat products.

4. Conclusion

The complex self-sustaining technical system that connects three production systems including the meat product production system, the egg production system and the electricity production system, considered in this manuscript has multiplied benefits:

- Production of high quality meat products;
- Production of high quality eggs and meat from chickens;
- Production of electricity from bioenergy, obtained by using the biogas created from waste materials from the egg production system and the meat product production system and used for the needs of the production capacity;

The operation of a biogas plant is one of the most cost-effective, modern and ecologically justified solutions for obtaining electricity, especially if it is obtained from substrates of own production. The burning of biogas results in minimal, almost no pollution of the surrounding environment, because it is a highly reactive gas and burns maximally without any residues, as shown by its measured values. The production of food products in such a complex technical system guarantees high quality of the products themselves. The high quality of the products is the result, among other things, of working in an ecologically clean environment, without additional pollution from their waste materials that burn in the process of obtaining electricity with minimal or no pollution. The multiplied benefits, verified through numerous microbiological tests, physico-chemical analyzes and tests for the emission of harmful gases in the air, are the result of the correct exploitation of such a complex self-sustaining technical system. The complete interconnection and dependence of all subsystems in this complex self-sustaining technical increases the difficulty and effectiveness of its management, but at the same time increases the benefits in relation to standard production technical systems. The existence of such a complex self-sustaining technical system is beneficial to every society, both in terms of reducing environmental pollution - its environmental suitability and in terms of the multiplied benefits arising from its operation - market competitiveness and thus represents the future of combined production.

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Figure 1. Monitoring the operation of a biogas plant

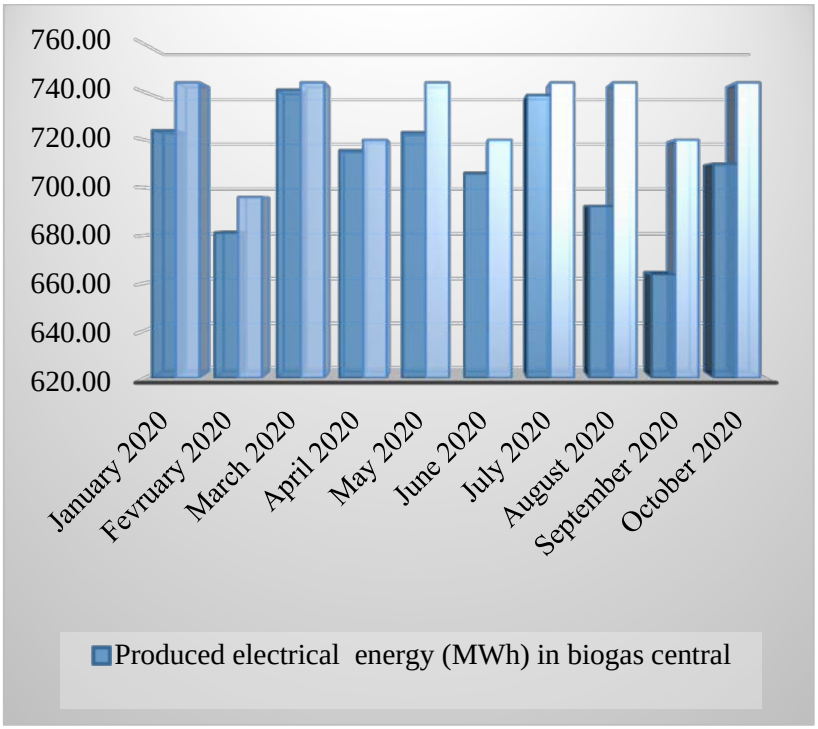

Figure 2. Presence of harmful microorganisms in % at five different samples

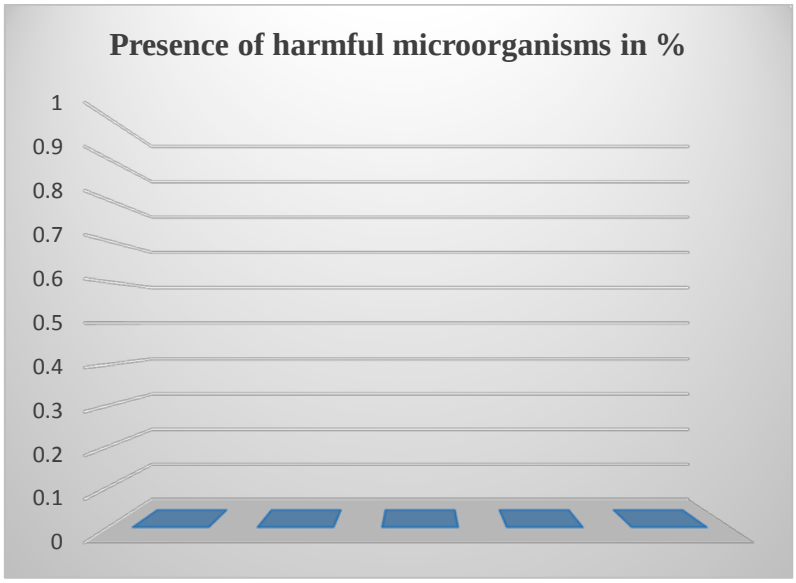

Figure 3. Data on microbiological correctness of sample units from report no. 003820

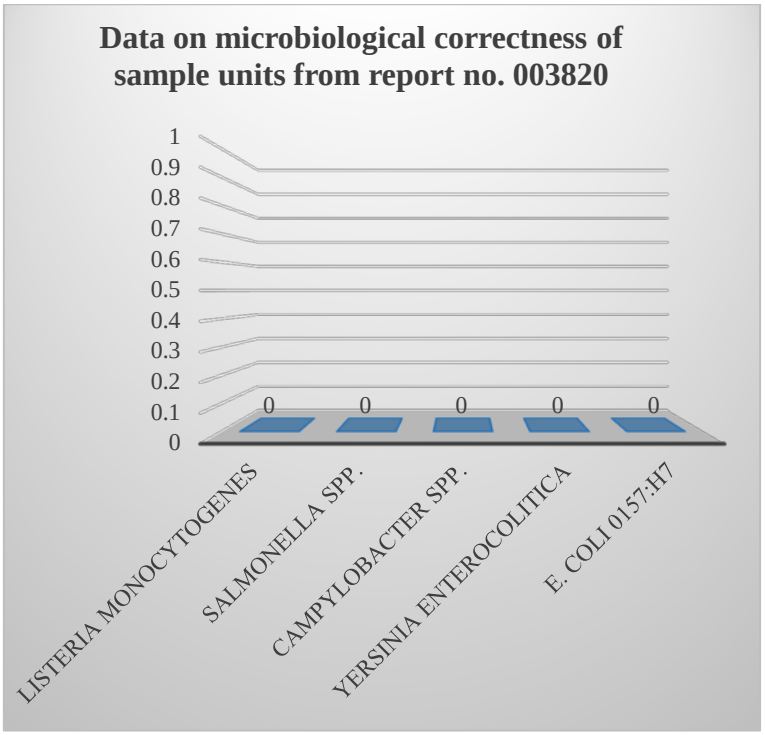

Figure 4. . Data on microbiological correctness of sample units chicken sausage "Seemiler"from report no. 0015520