SHORT COMMUNICATION

Use of native microorganisms in backyard poultry production in Burkina Faso

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Abstract

Objective: To characterize the effect of native microorganisms on backyard poultry production in western-central Burkina Faso.

Materials and Methods: The study was divided into two parts: broilers and laying hens. Two groups of growing broilers, three months old and 0,54 kg live weight as average (ten broilers per group) were used. A complete randomized design was applied to determine the growth dynamics of the animals for 75 days. During this period, egg laying was evaluated for two batches of laying hens averaging five months of age and 0,82 kg live weight (10 hens per treatment). Two treatments were established: T1) typical farm diet, T2) typical diet, plus combined inclusion of native microorganisms in drinking water and feedstuffs at the rate of 6 mL/animal/day and 4,0 % of daily dry feedstuff weight, respectively.

Results: There were no significant differences between treatments with regards to broiler growth. The final live weight was 0,93 kg, with a gain of 0,005 kg/chicken/day. Laying hens did not differ in growth either, with an average of 0,003 kg/day and a final weight of 1,02 kg. Broilers had high mortality (50 and 30 % for T1 and T2, respectively). However, no deaths were recorded in laying hens. Egg laying did not differ between treatments either, but egg weight in T2 was higher ($p < 0,05$) than in T1, with 40 and 30 g, respectively.

Conclusions: There was no evidence of a significant effect of native microorganisms on the productivity of the poultry flock, but there was evidence of a significant effect on egg weight and viability of the animals under study.

Keywords: poultry feeding, hens, broilers

Introduction

Burkina Faso is an agropastoral country, where the animal husbandry sector occupies more than 80 % of households in rural areas and constitutes its second most important productive sector (Tiemtoré, 2004).

One of the multiple manifestations of its family agriculture is backyard animal husbandry. This deals with the rearing, management and production of native, creole or bred animals in places adjacent to the dwellings, which constitutes a central element, as a source of occupation and food production for the family (Alayón-Gamboa, 2015).

Backyard poultry farming is the most widespread form of animal production. It is based on the small-scale use of chicken, turkeys, ducks, geese and other birds in or around the backyard of the house. Its purpose is to supply the family with products such as meat, eggs, feathers and fertilizer (Hortúa-López *et al*., 2021).

One of the main constraints for the development of poultry farming in Burkina Faso is the feeding and adaptation of imported breeds, which induces huge losses in the various animal husbandry farms in the country. An alternative to this feeding problem may be the technology of native microorganisms (NM) and their use as an additive in animal diets (Saro *et al*., 2017), which is promoted in the region by the French association *Terre et Humanisme*, founded in 1994, whose objective is to promote and transmit agroecology in France and internationally (Cazenave, 2015).

Modulation of the intestinal microbiota with new feed additives, such as probiotics, prebiotics and beneficial microorganisms, works in favor of health and is a trending topic in animal husbandry. In this type of compounds, lactic bacteria are the most used and there is enough information about the impact of such additives on concentrate feeds for host animals (Álvarez-Perdomo *et al*., 2017; Otálora-Porras, 2020).

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Based on the above-explained facts, this research aimed at characterizing the effect of native microorganisms on backyard chicken production in central-western Burkina Faso.

Materials and Methods

Location of the study. The work was carried out at the Farm School of the Association for the Promotion of Sustainable Agriculture-APAD Sanguié de Réo, located in sector 9 of Réo (Koroly), 10 km from Koudougou, in the central-western region, and 115 km from Ouagadougou, the capital of Burkina Faso, under local peasant production conditions.

Bioproduct elaboration. Decomposing forest mulch was collected in a forest in Mantiuélé, 60 km away from Réo. This litter (48 kg) was mixed with millet bran (120 kg), milk (14,4 l), bee honey (14,4 l) and chlorine-free well water (72 l). The mixture was fermented in airtight tanks for one month. From this solid mixture (1 kg), the liquid was prepared using 1 kg of unrefined sugar and well water up to 20 l and stored for one week under anaerobic conditions in the absence of light for later use.

Animals and treatments. The study was divided into two parts: one with broiler chicken and the other with laying hens. Two groups of growing broilers, averaging three months of age and 0,54 kg live weight (ten broilers per group), were used in a complete randomized design to determine the growth dynamics of the animals for 75 days, from July to September, 2019. During this interval, the growth and egg laying of two batches of laying hens averaging five months of age and 0,82 kg live weight (10 hens per treatment) were evaluated. The treatments were: T1) typical farm diet and T2) typical diet plus combined inclusion of NM in drinking water and feedstuffs at a rate of 6 mL/animal/day and 4,0 % of daily dry feed weight, respectively. The typical diet was offered twice per day and consisted of a mixture of protein sources: ground cowpea [*Vigna unguiculata* (L) Walp] mixed with moringa powder (*Moringa oleifera* Lam), ground corn (*Zea mays* L.) and salt. Table 1 summarizes the amount of feedstuff supplied per category and per day, as well as the inclusion of NM.

Bioproduct genomic characterization. Total genomic DNA was extracted from 25 g of solid sample and 10 mL of liquid sample, with the use of the FastDNA™ SPIN kit (MP Biomedicals, CA, USA), with modification of the manufacturer's instructions. DNA extracts were purified by adding guanidine thiocyanate (5,5 M). DNA was suspended in 150 µl of elution buffer. High-throughput sequencing was performed on ADNID (Montpellier) with the MiSeq Illumina system, targeting the 16S rRNA gene with the 515F / 806R primer set and the ITS gene with the ITS3F-ITS4R primer. Sequences were nested and operational taxonomic units (OTUs) were defined, by clustering at 3 % divergence (97 % similarity) followed by removal of singletons and chimeras. Final OTUs were taxonomically classified using BLASTn against a curated database derived from GreenGenes and SYLVA.

Live weight, kg. All the animals were weighed at the start of the experiment and on a weekly basis until completion.

Mean daily gain (g/bird/day). It was estimated from the final and initial weighing of the selected animals, divided by the number of days.

Egg production (u). The total number of eggs produced in each experimental group was counted daily.

Egg weight (g). The total eggs in each group were weighed daily and divided by the obtained production.

Viability (%). It was estimated by the formula EHA/IE x 100 (EHA-existence of healthy animals, IE-initial existence).

Mortality (%). It was determined by the formula:

$$\text{Mortality} = \frac{(DA)}{EI} \times 100$$

where

DA: dead animals and EI: final stock.

Statistical analysis. The Student's t-test (Brower *et al*., 1998) was applied using the statistical package IBM SPSS version 22, 2013, to determine whether or not there were significant differences between the means of the two groups. Descriptive

Table 1. Supplied feedstuffs and inclusion of native microorganisms (NM).

Categories	Quantity of feedstuffs per animal daily, g	Quantity of total daily feedstuff, g	Total quantity of NM per day/group, mL
Broilers	70 - 90	700 - 900	91
Laying hens	110	1100	97

statistics were also performed for the indicators under study.

Results and Discussion

Product characterization. The solid form of native microorganisms was characterized by a dominance of species of the genus *Lactobacillus*. In fact, of the nine bacterial species that had an abundance higher than 1 %, four species of *Lactobacillus* (*Lactobacillus secaliphilus*, *Lactobacillus amylovorus*, *Lactobacillus helveticus* and *Lactobacillus panis*) accounted for 57,2 % of the total bacteria present. *L secaliphilus* represented 31,7 % and *L. helveticus* 14,5 %. *Acetobacter pasteurianus* and three *Bacillus* species (*Bacillus fumarioli*, *Bacillus niacini* and *Bacillus nealsonii*) were also identified in this batch. The stock solution, was also dominated by five species of *Lactobacillus*, which totaled 65,8 % of the total abundance, among the 11 ones that had abundance higher than 1 %, were *Acetobacter pasteurianus* and *A. orientalis* (7,3 %), *Lactococcus lactis* (6,4 %) and *Enterococcus durans* (4,6 %).

These results, with the exception of fungi and yeasts (where the fungus *Acidea extrema* dominated), are in agreement with the report in international literature about the microbial composition of other microorganism products from mulch collected in forested areas, where populations of facultative microorganisms are found that subsequently multiply through solid-state fermentation methods (Laguna and Martinez, 2018; Otálora-Porras, 2020).

Product evaluation in broiler chicken. Figure 1 shows that broilers that received NMs had better growth, from the beginning of the experiment until the time of sampling six. Thereafter, the results were equalized until the end of the experiment. In general, in both groups, weights close to the kilogram (0,93 kg) were found.

In terms of daily gains, there were no significant differences between groups, with an average of 5 g/animal/day. In general, gains were low, typical of backyard farming systems in the region, based on local, not properly balanced feeds (Alders *et al*., 2018).

Regarding the effect of NM, the results are in agreement with those obtained by Berovides (2018) and Şahan *et al*. (2020). These authors found no impact of their use on growth. The former used them in the same proportion as in this trial compared with the consumed dry feedstuff, and the latter in drinking water (1,0 mL/l water).

In broilers, those that did not receive NM had better growth during the first 34 days, which corresponded to the second sampling time (fig. 2). Afterwards, growth decreased and they finished with the same live weight as those that received the additive (1,02 *vs* 1,05 kg, respectively). There were also no significant differences in daily gains, which did not exceed 3 g per day.

In terms of animal health, the viability of the broilers that did not receive NM was only 20,0 %, because eight of the ten animals became sick. Of these, five died, so mortality was 50,0 %. The chicken that received NM had viability of 50,0 % (five became sick); while three died, for a mortality of 30,0 %. In the two groups, the laying hens did not show mortality, although the viability of the treatment that consumed NM was better (90,0 *vs*. 60,0 %; respectively).

The high mortality rate in broilers is characteristic of small-scale poultry systems, which usually show limited or absent management conditions and hygiene and biosecurity measures. This situation worsens, due to limited or absent contact

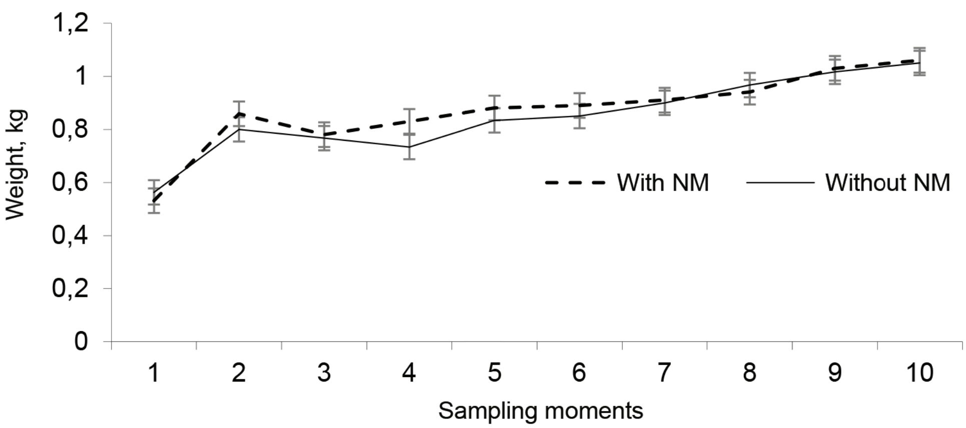

Fig. 1. Effect of the inclusion of native microorganisms (NM) on broiler growth.

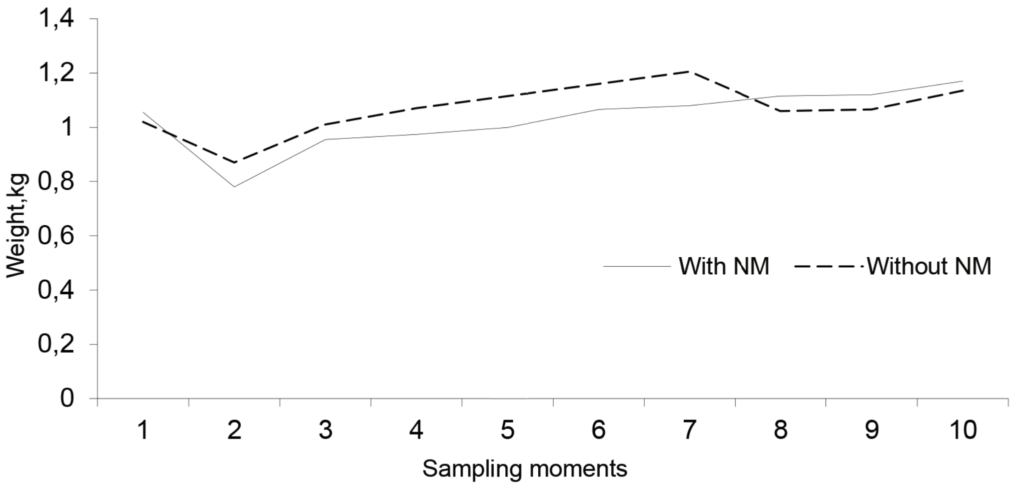

Fig. 2. Effect of the inclusion of native microorganisms (NM) on the growth of laying hens.

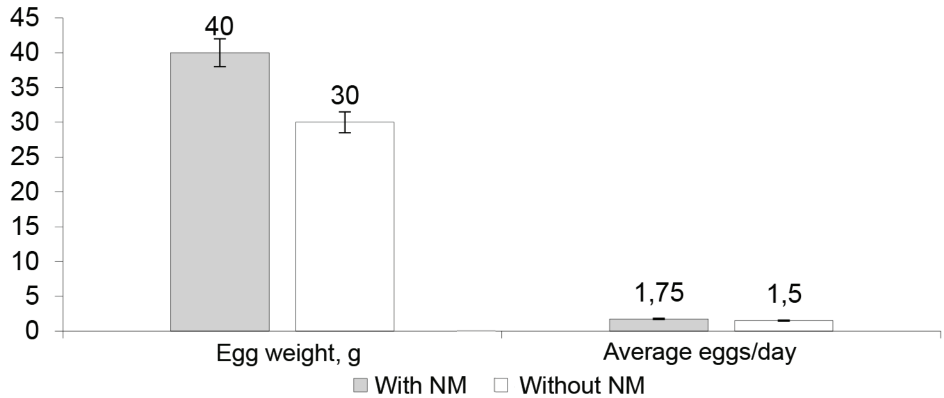

Fig. 3. Effect of the inclusion of native microorganisms (NM) on egg laying and weight in hens.
$p < 0,05$

with veterinarians for early detection of diseases (Manning *et al*., 2015). In this case, the main causes of diseases and deaths were related to external parasitism (ticks), enterobacteria and predator injuries, which is consistent with the report by FAO (2013).

Regarding total egg production, there were no significant differences between treatments (fig. 3). Production was low, as 1,23 eggs were produced daily per flock of 10 hens. However, the average weight of laid eggs was higher ($p < 0,05$) by 10 g in hens that received microorganisms in the diet. This suggests a positive effect of the bioproduct on this indicator, from a better balance of the intestinal microbiota, causing increased epithelial hairiness and improved availability and nutrient absorption rate (Vega-Rodriguez and Quintero-Gallardo, 2017).

The results were lower than those found by Berovides (2018) and Şahan *et al*. (2020), who obtained weights above 60 g, but with specialized White Leghorn and Babcock Brown laying hens, genetically different from the rustic hens used in this backyard trial.

Conclusions

There was no evidence of a positive effect of native microorganisms on the productivity of the studied local poultry flock, but there was evidence of a positive effect on egg weight and on the viability and mortality of the animals under study.

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Conflict of interests

The authors declare that there is no conflict of interests among them.

Authors' contribution

- Oula Zoumana Ouattara. Elaborated the protocol, executed the experiments with the corresponding measurements, searched for bibliographic information and wrote the scientific research report.
- Yuván Contino-Esquijerosa. Participated in the elaboration of the protocol, processed the scientific information, searched for bibliographic information and participated in the writing of the article.
- Hélène Beaulieu. Assumed the coordination and local logistics of the activity in relation to APAD and reviewed the article.
- Paula Fernandes. Coordinated the project, participated in the elaboration of the protocol and participated in the review of the scientific report and in the writing of the article.
- Komi Assigbetsé. Characterized the microbial composition of the solid and liquid MS and reviewed the article.
- Jesús Manuel Iglesias Gómez. Processed the scientific information, searched bibliographic information and wrote the article.

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