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Prospects of Integrating Caviaculture and Fish Farming in the Western Region of Cameroon

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Abstract

This study was conducted within three months at the University of Dschang Research and Application Farm (5°44'-5°36' et 5°44'-5°37' LN ; 10°06'-9°94' et 10°06'-9°85' LE). The main objective was to evaluate the integration perspectives of caviaculture and fishery. Specifically, the study was aimed at evaluating the production of guinea pig dungs, its bromatological composition and appreciating the nitrogen/phosphorus ratio in other to determine the adequate quantities of manure for a proper fertilization of fish ponds. Hence, 96 guinea pigs weighing averagely 390 ± 110g each were randomly distributed into two comparable lots (floor covered with litter and floor without litter) and were subjected to 8 feeds (5 grasses and 3 legumes). Each lot had 6 repetitions of 8 individuals. The animals were fed three times daily within 30 days. The dungs of guinea pigs were collected after three days between 6 and 8am during the experimental period. They were then selected and weighed using and electric balance of 0.1g sensitivity. At the end of the study, the following results were obtained: a guinea pig of 390 ± 110 g in confinement produced between 51.7 ± 0.4 to 60.5 ± 0.7g (fresh weight) of dung per day. The bromatological analysis of these dungs showed that they are made of organic material (80.0%), dry matter (94.3%), crude protein (10.7%), ash (19.9%) and nitrogen (22.7%). These results attesting the richness of these dungs helped in estimating the quantities (103.4g to 206.8g) of dung/day/100m² for the breeding of 2 to 4 guinea pigs per fish pond of 100 m² for an integrated breeding (guinea pig-fish).

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Introduction

Malnutrition is one of the main problems that African populations suffer and this is particularly linked to a deficit in protein especially animal protein [1]. In fact, the consumption of different categories of meat barely reaches 20g/inhabitant/day that is more 10g less than the minimum 33g minimum recommended by WHO [2]. FAO [3] suggests that the intensification and diversification of production systems will be a great tool in establishing a balanced diet for the populations. Integrated fishery is therefore proposed as a promising alternative to increase the availability of proteins especially in African rural localities. In Sub-Saharan Africa particularly in Cameroon, fishery is one of the principal sources of animal protein for human population. However, it emergence collides with many constraints such as feed. Adequate experimentations of feed manufacturing based on local by-products have been developed but they face tough competition with other speculations (fowl, pig, etc.) towards essential ingredients. Hence, there is necessity of alternative feeding sources ([4]; [5]; [6]) and this is also due to the fact that many inputs available to farmers are of low nutritive value [7]. However, the improvement of pond yields through fertilization is a practice used for a long in the world. [8]. Fertilizers are products whose use helps in the maintenance and improvement of primary production and the physical, chemical and biological properties of the pond [9]. Nevertheless, their use in fisheries remains limited due to the high competitiveness of agricultural [10] and the nature of large zooplankton produced [11]. In fact, these fertilizers promote a majority production of large zooplankton [11]. Caviaculture is one of the new speculations of animal husbandry of family farms which is strongly promoted today in Cameroon ([12]; [13]; [14]). Actually, this breeding is very promising due to the fact that breeding guinea pigs does not need a high capital, their meat are of good quality, no odour and they are suitable as a pet with a ready market ([15]; [16]). However, there has been no integration of guinea pig's dungs in fishery although they may be an alternative source with regards to fertilizers for the production of zooplanktons. Hence, the objective of this study is to contribute to the evaluation of the potentialities of a caviaculture and fish farming integration in the Western Region of Cameroon. Specifically, this study is aimed at evaluating the production of guinea pigs dungs, its bromatological composition and appreciating the nitrogen/phosphorus ratio in other to determine the quantity of manure necessary for a proper fertilization of fish ponds.

Methodology

Study Zone

The study was undertaken at the University of Dschang Research and Application Farm (FAR) and in the laboratory of Animal Nutrition of the University of Dschang with the following geographical coordinates: 5° 44'-5°36' and 5°44'-5°37' Latitude North; 10°06'-9°94' and 10°06'-9°85'Longitude East and an altitude of 1394 m in the Western Region of Cameroon. It has a Cameronian climate with an altitude characterized by a short dry season (mid-November to mid-March) and a long rainy season (mid-March to mid-November). Rainfalls vary between 1500 and 2000mm per year with an average of 1800mm and an average temperature of 22°C [17].

Animal Material

The guinea (*Cavia porcellus*) pigs used in this study were bought from peasants from the Menoua division, Western Region of Cameroon. A total of 96 (48 males and 48 females) guinea pigs weighing between 390 and 500g averagely were bought from local markets (Bafou and Fongo-Tongo).

Housing

The study was conducted within a special building of 50 m² which protects the animals from rain, sun; excessive cold and predators while providing them light with good ventilation. In this building, 96 guinea pigs were uniformly distributed in 12 boxes (of 7.2 m^2) separated with the help of plywood placed on cemented floor. Six (6) boxes were covered with a layer of litter made of white wood chip and six were without litter.

Feeding

These Animals were Fed 3 Times/Day with 8 Different Feed

Bracharia ruziziensis, Trypsacum laxum, Panicum maximum, Pennisetum clandestinum, Pennisetum purpureum, Arachis glabata, Desmodium intortum, and Calliandra calothirsus harvested two times

per week from the university campus and its environs.

Experimentation and Data Collection

96 (48 males and 48 females) adult guinea pigs (*Cavia porcellus*) weighing 390 ± 110 g averagely were used. These animals were randomly distributed into two lots and maintained in 12 identical boxes of 0.6 m^2 each (4 males and 4 females of comparable weight per box). From these 12 boxes, six (6) had a floor covered with 375g of litter and six had an empty floor. Within 12 weeks (3 months), these 96 individuals were reared and fed 3times/day (7-7:30am, 12-12:30 and 5:30-6pm) with *Bracharia ruziziensis, Trypsacum laxum, Panicum maximum, Pennisetum clandestinum, Pennisetum purpureum, Arachis glabata, Desmodium intortum,* and *Calliandra calothirsus.* The guinea pigs dungs were collected after 3 days at the same time between 6 to 7 am within the experimentation period. After cleaning the boxes, the dungs from the floor without litter were separated from feed debris and weighed while those from the floor with litter were equally separated from feed debris and weighed with litter using and electric scale (CAMRY). The weight of the dungs from the littered floor was then separated from that of the initial litter in other to evaluate the quantity of dung produced. After this collection, three samples per lot were taken for bromatological analysis in the laboratory of Animal Nutrition of the Faculty of Agronomy and Agricultural Science (FASA) of the University of Dschang as described by Kjeldhal [18] in other to determine the nitrogen and phosphorus content as described by Pauwels et *al* [19]. The analysis helped in evaluating the quantity of dungs necessary for the fertilization of a fish pond with a known area and to know the number of guinea pig to be reared in a fish pond with a known area.

Evaluation of the Quantity of Dung Produced by a Guinea Pig

At the end of the experiment, the total quantity of dung collected from the littered floor was determined. This quantity deduced from that of the litter helped to determine the exact quantity of dung produced by the animals. In the second lot without litter, the calculation method was the same with the exact quantity of dung produced directly obtained without litter.

Statistical Analysis

In other to compare the differences between the nature of the floor and the breeding boxes for the collection of dungs of guinea pigs, the different data collected were subjected to the test of student. The Ducan test was used to separate means at a threshold significance of 1% when there was significant different between the means. The SPSS 21.0 software was used for the analysis.

Results and Discussion

Productivity of Dungs of Guinea Pigs

Table 1 shows the productivity of guinea pigs dungs by animal reared on a littered and empty floor respectively.

The quantity of dungs collected was greater when the floor was covered with litter. Hence, 60.53±0.64g and 51.69±0.36g of dung/guinea pig/day were respectively collected from a littered and empty floor. This weight difference is significant at a threshold of 1% ($p<0.01$). This might be due to the fact that the litter that absorbed urine was not taken into consideration during the weighing of the weight and calculations. Urine has good nitrogen content. It would be therefore appropriate to advise farmers to collect dungs from a littered floor. Hence, not only the biomass

Table 1. Production of guinea pig dungs

Period / Methods	Daily (g)	weekly (g)	Monthly (g)
Without litter	51.69±0.36^{b}	361.83±2.53^{b}	1550.7±10.83^{b}
With litter	60.53±0.64^{a}	423.71±4.49^{a}	1815.9±19.26^{a}

a and b: means with the same letters on the same line are not significantly different (P>0.01)

would be high, but also the nitrogen content.

Dry Matter Productivity of Guinea Pig Dung

The daily dry matter productivity of guinea pig dung per animal is summarized in table 2.

The percentage of dry matter is high with or without litter (94.28%) which is an evidence of low moisture content of 5.72%. Hence, the dungs of guinea-pigs present a good content of dry matter available for the production of planktonic biomass and the direct feeding of fish species in heterotrophy ponds. This is in accordance with the works of Dabbadie *et al* [20] which stipulate that when an organic particle enters water, it future doubles. It is either consumed directly by heterotrophic especially some fish or degraded to release mineral elements which permits the production of phytoplankton by photosynthesis. However, FAO, [21], Dabbadie *et al* [20] and Pouomogne [22] determined the maximum safety level of animal organic matter in cool and temperate climate of 0.6kg DM/ j/100m^2 fish pond and in hot and tropical climates of 1.2 kg DM/100m^2/j fish pond.

Chemical Composition of the Dungs of Guinea Pig

The different chemical components of the guinea pigs dungs are presented in table 3 and 4.

Table 3 summarizes the crude protein, ash and organic matter contents of dungs. The different percentages of the crude protein, ash and organic matter are respectively 10.65%; 19.89% and 80.01%. This explains the richness of these dungs in nutritive elements which are available for the feeding of different fish species. The crude protein content (10.65%) in the guinea pigs dungs corroborates with the results obtained by Friote [23] and Pouomogne [24] on the crude protein content of some plants and fruits often used for the feeding of fish and fertilization. They explained that crude protein contents between 6 and 26% give good yields. This high content of organic matter (80.01%) is largely greater than 15% obtained with pig manure and slightly less than 88% in chicken droppings obtained by Efole [25]. This content (80.01%) of organic matter is high for the fertilization of fish ponds in other to stimulate the natural production of phytoplankton and zooplankton.

After the conversion of percentages into grams, it is noted that in 51.69g of dungs produced, there exist 11.74g of nitrogen and 0.38g of phosphorus. The high quantity of nitrogen noted in the dungs can be due to the high protein content of feed. Therefore, these dungs can be of great aquaculture interest as the N/P ratio of the inputs is an important factor for the organic fertilization of fish ponds. According to Pouomogne et al [22], the nitrogen and phosphorus quantities in water have to be 1mg/l and 0.5 mg/l respectively. Moreover, in Thaïland having weather conditions (average temperature=25°c, average altitude=1778.33m) similar to that of the Western Region of Cameroon Knud-Hansen [26] noted that there is no universal recipe for the maximum rate of nitrogen and phosphorus fertilization because of the variability of fish ponds (every fish pond has its specificity). However, Knud-Hansen [26] stated that this rate might be around 30kg of nitrogen/ha/week and 10kg of phosphorus/ha/ week in the breeding of tilapia that is 42.85 g/day/100 m^2 and 14.28 g/day necessary /100 m^2 respectively. Lin et al [27] proposed contributions made between 20 and 40g of nitrogen/100m^2/day. Also, Edward [28] noted that in Thaïland 2 to 4 kg of organic nitrogen /ha/day are necessary for the production of 7.3 and 10.95 tons of fish/ha/year in the breeding of tilapia. According to

Table 2. Daily dry matter production of guinea pig dung per animal

	Floor with litter	Floor without litter
Weight of fresh dung (g)	60.53± 0 .64^a	51.69 ± 0.36^b
Weight of dry matter (g)	57.06 ± 0.11^a	48.73 ± 0.07^b
% dry matter	94.28 ± 0.12^a	94.28 ± 0.05^a

a and b: means with the same letters on the same line are not significantly different (P>0.01)

Table 3. Chemical composition of the guinea pigs dungs in percentage of dry matter

Chemical composition of dungs	Dry matter	Crude protein	Ash	Organic matter
Percentage (%)	94.28 ± 0.12	10.65 ± 0.20	19.89 ± 0.01	80.01 ± 0.21

Table 4. Mineral content of guinea pigs dungs

Minerals of dungs	Total minerals (%)	Nitrogen (%)	Phosphorus (%)
	19.89 ± 0,50	22.715 ± 0,32	0.74 ± 0,21

the nitrogen production by guinea pigs and propositions of the above mentioned authors, 2 to 4 guinea pigs/ day/100m^2 is necessary for the individuals to produce 20 to 40g of nitrogen/day as recommended by Lin et al [27] and Edward [28]. These animals have to produce between 88.06 to 176.12 g of dungs per day. These numbers can give an expected result of 10.21tons of fish/ha/year. However, according to Dabbadie and Lazard [20], during integration, the number of animals varies with the intensification level, weight and age of the animals.

Conclusion

At the end of this study on the prospects of integrating caviaculture and fish farming in the Western Region of Cameroon, it appears that the production of guinea-pig manure is of the order of 60.53 ± 0.64g when the floor is littered and of 51.69 ± 0.36g when the floor is not covered.

The bromatological analysis showed that the guinea pig dungs have high content of organic matter (80.01%), dry matter (94.28%), ash (19.89%), crude protein (10.65%), nitrogen (22.715%) and phosphorus (0.734%). However, the phosphorus content has to be improved in other to optimize production.

From these results, one can conclude that the integration of caviaculture-pisciculture is possible with a lot of interest taking into account based on these interesting bromatological values obtained. This is because the fertiliser is effective when it has high nitrogenous and phophorus content.

With regard to all these quantities of nitrogen and phosphorus in the dungs, a ratio of 2 to 4 guinea pig/ 100m² fish pond can be proposed but corrections should be made as regarding the phosphorus content which is slow in the dungs. This type of breeding (integrated breeding) helps in the reduction of production cost.

However, the study should be extended for a longer period of time by including tests (experiments) in fish ponds.

Conflict of Interest

There are no conflict of interest among authors for this article.

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