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Analysis of the same Parameters (pH, MM and DM) in the Organic Fertilizers used in the Urban Agriculture in Burkina Faso

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ABSTRACT

The organic fertilization seems to be one of the suitable solutions to solve the problem and to overcome the biological, chemical and physical affluence problems of the soils. This study has as target to make a chemical and physical characterization of the organic substrates of animal origin used in the outskirts and in the urban agricultures. Hence, some manure from seven (7) categories of animals were identified and took away on different areas and were analysed in a laboratory to determine pH, dry matter (DM) and mineral matter (MM). The results reveal that the lowest contents of DM (91.1% of DM) and of MM (25.5% of MM) were respectively obtained in the poultry droppings and in pigs manure. Likewise, the sheep, cattle and goats manures were basic (pH varying from 7.9 to 8.3) while the ones of donkeys, pigs, poultry and rabbits were neutral (pH varying from 7.6 to 7). The results offer the possibilities to optimize their recovering as fertilizers for the crops or affluences for the soils.

Key words: *Animals manure, chemical analysis, urban agriculture*

INTRODUCTION

One of the problems of the farmers and especially of the small producers (smallholders) is the access to the agricultural inputs especially the crops fertilizers[19].

Burkina Faso is a country where the original poorness of the soils in potassium, their acidity and the expensiveness of the chemical fertilizers are the factors which limit the food crops and the income cultures.

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That is why the use of the organic fertilizers is the solution to overcome these constraints.

The excrements are the result of some complex biochemical reactions, consequence of an ingestion and digestion process of foods by animals. These effluents from breeding are a source of nitrogen and organic substance which is not insignificant. So, the manure plays an important role in the durability of the affluence of the soils either through the supply of some nutritive elements or through the improvement of its soil chemical and physical proprieties[8, 13,18].

However, these supplies give a big variability in the composition according to the type of breeding, the management, the mode of storage[7].

In addition, the food diet, the use and the frequency of litter removal, the modes of gathering and the practices of storage are some factors which can influence the content or the availability of the chemical elements contained in the animals excrements[5,7].

So, the composition of the manure can vary according to the species of the animal, the food intake and the fodder (content of water, content of structural sugar). However, the organic fertilization must be very well planned and balanced in order to allow a good feeding and to guarantee the availability of all the necessary elements (macro and micro elements) to the plant during its period of high demands[18].

Moreover, the different types of microorganisms of the soil have their own optimum pH of maximum growing. The optimum pH matching to the speed decomposition of the whole substrates is located between 6.5 and 8.5. The bacteria and the actinomycetes which have their optimum pH next to the neutrality compete but slightly with the nutritive elements in an acid area; this explains the plenty of mushrooms with an acid pH[15].

A good knowledge of the physical and chemical composition of the manure is then important and gives some better strategies in order to optimize their recovering as fertilizers of the cultures or as affluent for the soils in the Saharan regions recognized to have a weak ecosystem and for their great vulnerability to degradation.

This study which aims to determine the chemical and physical parameters (pH, MM, DM) of the animals excrements used in agriculture will show some ways to optimize their use.

MATERIAL AND METHODS

Site of the samples collected

The province of Houet, especially the town of Bobo-Dioulasso (West of Burkina Faso) was the zone where the study had been done. The province stretches as far as approximately 11,582 km² and is located at3°20’ and 4°60’ longitude west and at latitude 10°30’ and 12°20’ north. As far as the town of Bobo-Dioulasso is concerned, it stretches as far as 13,678 ha.

The agriculture only has 60 to 70% of the provincial population. The actors of the agricultural activity are either some cereal growers, market gardeners or some owners of a plants nursery etc. However, cereal growing is over the other agricultural activities during the rainy season. The products of the agriculture are the food-producing cultures (Maize/cornered and white sorghum, mille, rice) some income crops (Cotton, ground nuts, peanuts, sesame, yams, cowpea, manioc, taro) and some low-season cultures (fruit and vegetables). We note an association of agriculture and breeding for a good fertilization and abundance of fodder.

The samples were taken away in the breeding and agricultural running’s located in the outskirts and urban zone of the town.

Samples collected and laboratory analysis

The selection of samples of the selected breeding and agricultural farms to gather the data was done over 233 farms. The method of quota was used for the selection of samples according same reference[11]. This technique gives a similar structure to the population to be studied and fixes a survey rate at 14%. In our case, we have fix the survey rate at 24.50% which give about 57 running’s for the follow-up. For each species of animals (Table 1), some samples of manure were collected.

Table 1: Distribution of the number of manure samples per category of animals

Category of manure	Sample number
Cattle	05
Sheep	05
Goat	05
Pig	05
Poultry	05
Rabbit	05
Donkey	05
Total	**35**

Some distinct samples were taken away in different areas and in all depths (from 1 to 4 according to the quantity and the height stored) to make a heterogeneous sample. The heterogeneous sample of about 0.5 kg came from 4 to 8 elementary samples taken away from each type manure, after separating the superficial layers exposed to the climatic hazards[5]. Obtaining the main sample was the result of mixing the elementary samples of each type of manure[3].

All the samples collected and dried in the shade were taken to the Soil-Water-Plants laboratory of the agricultural and environmental researches station of INERA Farakoba to analyse the chemical and physical parameters (pH, MM, MS).

The parameters were definite as followed:

-pH: following AFNOR, (1999)[2].

-Mineral material (MM): it was obtaining through burning to ashes by placing the sample first obtained dry in an owen heated to 550°C for 6 hours. Cooling the sample in a desiccator and weighting the whole mass MM. Determining the percentage of the mineral matter through the formula % MM=100 x (MM-t)/(MO-t).

-Dry matter (DM): In a porcelain crucible first dried and tare (tare t), weighting the mass (m) of the sample. Putting in a sterilizer to 10°C till to obtain a constant sample mass. Cooling in a desiccator and weighting the whole mass MO. Determining the percentage of the dry matter: % DM=100 x (MO-t)/m.

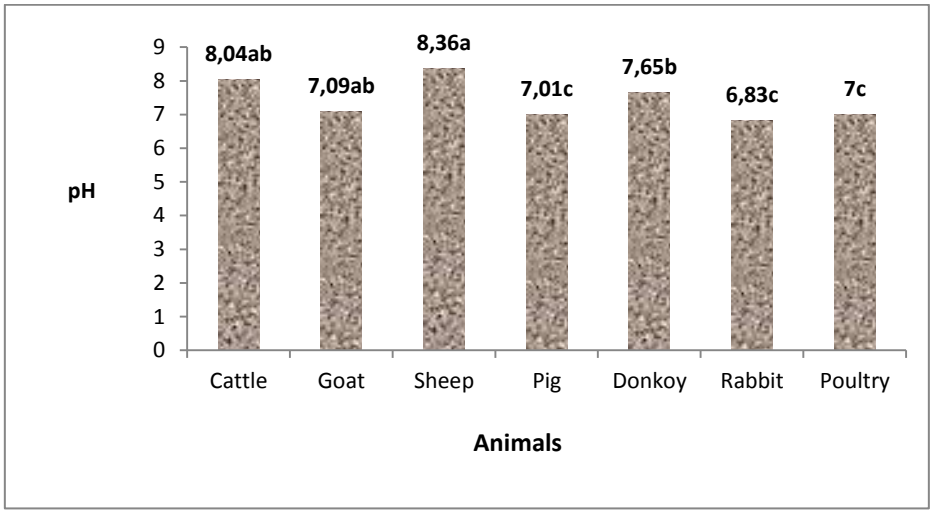
Statistic treatment of the data

All the gathered data were captured in the EXCEL table version 2010. The whole measured parameters (pH, DM, MM) was the object of a variance analysis (ANOVA) in order to compare the averages at the threshold of 5% through the test of Fisher with the software XLSTAT, 7.5.2 version.

RESULTS

Variation of the pH of the organic fertilizers

The results of the analysis of the variance (ANOVA) are shown in the figure 1. We noticed that the averages were statistically different (Test of Fisher at the probability threshold of 5%) for the whole types of the studied manure ($P<0.001$) talking about the pH. The manure of the monogastric animals (Poultry, pigs, donkeys, rabbits) was nearly neutral (pH varying around 7) while the one of ruminant animals (cattle, sheep, goat) was slightly basic (pH varying around 8).

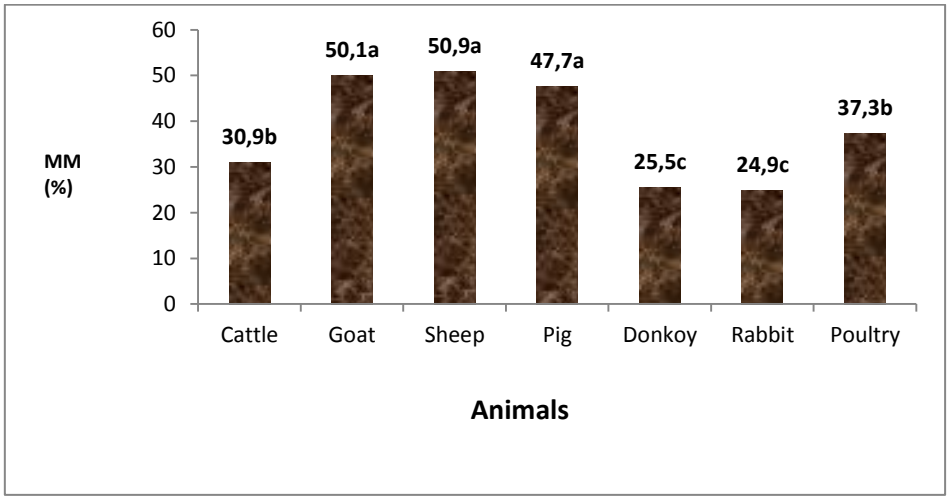


The values with the same letters in the histogram are not significantly different at the probability threshold of 5% according to the Fisher test.

Fig. 1: Average pH by category of organic fertilizers

Content of the mineral matter (MM) in the organic fertilizers

The figure 2 shows the results about the contents of the mineral material of the organic fertilizers. The test of Fisher revealed that the averages of the contents of the MM of the studied manure were highly significant (P<0.01). The content of the mineral matter (% MM) for the cattle and the poultry were statically the same. The highest contents of the MM (in %) were noticed in the sheep manure (51.9%) followed by the pigs and goats manures which were statistically the same. The lowest contents were noticed in the rabbit's manure (29.9%) and in the donkey's manure (25.5%).

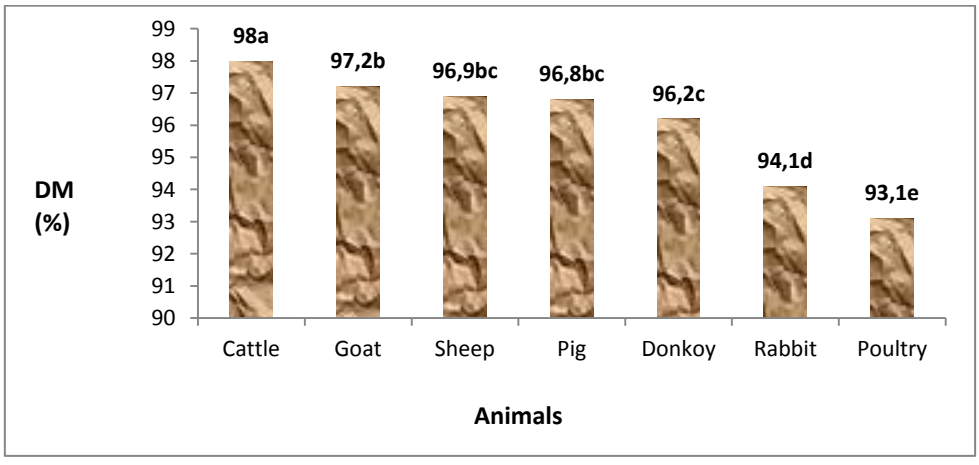


The values with the same letters in the histogram are not significantly different at the probability threshold of 5% according to the Fisher test.

Fig. 2: Mineral matter (MM) content in organic fertilizers

Dry matter (DM) rate of the organic fertilizers

The results about the rate of the dry material of the organic fertilizers are showed in the figure 3. The test of Fisher showed that the averages of the dry matter (DM) in the whole types of manure was highly significant (P<0.001). The rate of DM of the cattle manure was significantly the highest followed by the goats manure (97.2%), then the sheep manure (96.9%) and the donkeys manure (96.2%) which were statistically different.



The values with the same letters in the histogram are not significantly different at at the probability threshold of 5% according to the Fisher test.

Fig. 3: Dry matter (DM) variation in organic fertilizers

DISCUSSION

The pH of the whole studied manure showed some significant differences according to the test of Fisher at the threshold of 5% (Fig. 1). The pH varied from a minimum of 6.8 to a maximum of 8.3 respectively for rabbits manure and sheep manure. That meant that the manures of the studied area were in a range of pH slightly neutral to basic. The sheep, cattle and goats manure of a respective pH of 8.3, 8 and 7.9 were alkaline and their value higher than the rabbits one (6.8), than the poultry one (7), than the pigs one (7) and then the donkeys one (7.6). This difference would be influenced by the diet and by the food digestion process[20,21,22]. Some studies reported that the digestion of the cellulose is done by microbial fermentation and bacteria made the carbohydrate hydrolysis through their enzymatic capacity[21,22]. This is made in the specialized anatomic proportions to the omnivorous and herbivore animals.

Then, the neutral pH of the pigs, rabbits and poultry manures could favour a good microbial atmosphere favourable to the mineralization and the nitrification micro flora. The value of the pH of the sheep as well as poultry droppings was near to the one obtained by Toussaint and Dehareng (1998)[19] who found some pH of respective values of 8.1 and 6.8. Comparatively to our cattle manure (pH=8), the studies found some pH of respective values of 7.41 and 7.2[9,19] These two values being near but slightly low than ours. The obtained value of the pH of the donkeys manure (7.6) was very different of the one recorded who obtained a pH of 5.78 in India[14]. Many studies agree to say that the value of the pH depends on the composition of the fertilizers, the content of the nitrogen, the intensity of the nitrification during the storage and the physiologically level of the animal[12,6,7]. Same study[7] on sheep at the three physiologically levels (gestation, lactation and fattening) and two diets sustained this idea. Indeed, under two diets, they got the same pH=7.4 at the fattening level. A pH varying respectively from 7.7 to 8.2 with a hay diet and with a diet made up of some fresh plants first stored in a silo at the lactation level and a pH varying from 8.7 to 8.6 respectively for a hay diet and a diet made up of some fresh plants first stored in a silo at the gestation level.

The analysis of the variance of the rate of the mineral matter (MM) for the whole manure showed a significant effect ($P<0.01$) (Fig. 2). However, the recorded contents were different of those who obtained the contents of MM in the cattle manure, the sheep manure and the poultry manure respectively of 29.25, 43.31 and 51.33%[17]. Our results showed also a great variability of the contents of MM of the manures. Indeed, the goats, sheep and pigs manures had the contents of MM two times higher than rabbits and donkeys manures. Same an analysis of the animal's excretions got the contents of 50.2% in the cattle manure, 42.85% in the donkeys manure and 24.8% in the pig's manure[1]. These values are quite different of those we had found. In the opposite, the content of the MM in the goat's manure (53.3%) which they got was slightly near to our results (50.01%). The variations observed among the different groups would be strongly linked to the diet. This diversity of diets as well as the digestibility of each category of food by each type of animals would influence the content of the mineral material in the excrements. In the same way, some researches showed that the faecal digestibility of the minerals, of the nitrogen, of the fats, of the organic matter also decreased while the content of the dietary fibres increased[20,22]. Those authors assessed that the fibres cause some phenomena of high fermentations leading to an increase of the bacterial mass and some excrements containing a high rate of nitrogen material and in a low level, of fats.

Moreover, the results we got showed the solid aspect (A rate of DM high at 15%) of the samples of manures[5]. Our works are in the interval of those recorded in literature about the DM[4,17]. The rate of DM could be influenced not only by the type of animals but also the modes of gathering. However, generally speaking, the systems of management of the manures in the breeding running's in the subtropical Africa are

different from the systems of gathering separated observed in the intensive industrial breeding's of the European countries[10]. So, the meteorological conditions at the moment of the taking and the duration of the storage of the piles would have contributed to the lixiviation of the liquid fraction of the excrements by increasing the rate of DM. In the literature, it is already recorded an increase of the rate of DM with the duration of the storage[6]. Other works showed a decrease of the rate of DM from 77.18% (0-12 cm depth) to 68.11% (48-60 cm depth) in the holes of storage of the donkey's excrements[16].

CONCLUSION

This study about the chemical and physical composition of the manures allowed observing variability among the studied categories of organic fertilizers of animal origin. The ANOVA gave some significantly differences for the three analysed parameters (pH, MM and DM).

The diet of the different studied species was the most explanatory factor of the different contents of the chemical and physical elements.

This study of the mechanisms which influence the level of alkalinity of the animals excrements present, then, an important challenge in our context where the soils are very acid and poor of organic material.

The high level of alkanility in the ruminants manure shows that these types of fertilizers can be good as fertilizers for the soils which are acid in our zone of study.

With this knowledge, some methods of improvement of the cultures income and the development of the soils will allow a best vegetal production in order to satisfy a demand always increasing.

The different studied manures have each an intrinsic characteristic which is worth thinking about for agronomical development.

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