Chemical characterization of an ensiled food for pigs. Technical note

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To characterize chemically an ensiled, mainly as energetic food, obtained from ensiling sweet potato (*Ipomoea batata*), *Saccharomyces cerevisiae* cream, concentrated vinasse and B sugar cane molasses, pH and dry matter percentage (DM), ashes, crude protein (CP) and crude fiber (CF) were determined to food samples, obtained at laboratory scale and in an industrial plant. The silage, produced in both conditions, showed 24.63-33.75 % of DM; 11.27-13.96 % of ashes; 9.66-11.15 % of CP and 3.78-3.61 pH. According to these results, it is considered that sweet potato silage has the appropriate chemical characteristics to be used in the alternative pig feeding.

Key words: *ensilage, pig food, chemical composition, concentrated vinasse, B molasses.*

The animal feed systems are supported in the use of grains, mainly soybean and corn, which are also part of human feeding. Currently, these grains are evaluated for their utilization in the production of biofuels (ethanol and biodiesel).Thus, it is needed an endless search for alternative feeds, permitting higher availability to balance animal diets (Rodríguez *et al.* 2011).

The use of agro-industrial products and by-products in animal feeding is a viable alternative in the tropic. Tubers, roots, distillery creams, sugar cane molasses, as well as meals of grass and legume forages, are alternative foods. However, many times, due to its characteristics, techniques or treatments are applied to increase the final product quality, to reduce the production cost and to properly use the potentially pollutant materials (Guzmán *et al.* 2012).The ensilage technique has demonstrated to be an appropriate alternative to preserve and improve the nutritive value of pastures and grains (González *et al.* 2012), agro-industrial wastes of tropical fruits (Guzmán *et al.* 2012), tubers and roots (Cabrera *et al.* 2012 and Caicedo 2013), among other foods.

The previously stated was considered for the study of new products and agro-industrial by-products combination (sweet potato, yeast cream, concentrate vinasse and B sugar cane molasses), and the obtaining of an ensiled food for feeding pigs. The objective of this study was to characterize chemically the sweet potato silage, obtained at laboratory scale and in an industrial plant, for its use as alternative food.

The study at laboratory scale was carried out in the Instituto de Ciencia Animal (Mayabeque, Cuba) between February and May, 2012. Glass flasks of 500 mL were used as experimental units, with an effective volume of 440mL. The food resulted from ensiling a mixture of sweet potato (*Ipomoea batata*), yeast cream (*Saccharomyces cerevisiae*), B sugar cane molasses and concentrate vinasse, according to know-how in patent process. The characteristics of these sources were: sweet potato with less than 1% of ground and dirt, without sweet potato weevil (*Cylas formicarius*), 24-30 % of DM and 1.5-1.8 % of CP; thermal cream with 18-22 % of DM, 34-35 % of CP and 4.5-4.7 of pH; B molasses with 75-80 °Brix and 75-80 % of DM and concentrate vinasse, from the rum factory "San José Havana Club International", with 27-32% DM, 28-32 total soluble solids, 8-10 % of CP and 4.0-4.5 of pH. The pH indicator of ensiled food samples was determined in pH digital meter (Sartorius), ± 0.01units precision, and DM, ashes and CP percentage (n=3) were also determined, according to AOAC (1995).

Cited indicators were also determined to the samples of four batches of sweet potato ensiled, produced in the factory built in the Unidad Empresarial de Base (UEB) "Héctor Molina", in San Nicolás, Mayabeque province, Cuba. Samples (n=23) were taken from the valve and the center of the tank in which the product the pig unit from the Instituto de Ciencia Animal is during the period from June to September, 2012, according to the methodology described by Scull *et al.* (2012). The percentage of calcium and phosphorous was also determined, according to AOAC (1995). Position and dispersion statistics (mean, standard deviation and variation coefficient) were determined to all data, with the statistical package Infostat (Di Rienzo *et al.* 2012).

Tables 1 and 2 show the chemical composition of food, obtained at laboratory scale and in an industrial plant, respectively. Every result presented low variation percentages, except the CF. Mean content of dry matter of the silage, obtained under both conditions, was found between 24.63 and 33.75 %, with similar values to those of sweet potato and other sources used in the formulation. The root of sweet potato or its meal showed low indicators of CP (1.80-5.20 %), according to Bernal *et al.* (2012). Therefore, mean values of this indicator in the silage (9.66-11.15 % in DB) is a result from the protein contribution of the yeast cream and vinasse used, and to the contribution of microbial protein synthesized during the fermentative process, occurring in the silage.

As the tables show, percentage of CF was 2.21-2.92 % in dry bases, where low values were expected, considering that any of the raw matters were fibrous. Values of pH of the silage obtained in the laboratory and in the pilot plant were also low. This could be the result, mainly, to the presence of organic amino acids provided by the thermal yeast cream (pH 4.5-4.7) and distillery vinasse (Hidalgo *et al.* 2009). This last can have mean pH values of 3.92-4.08, according to the reports of Scull *et al.* (2012). In addition, during the ensiled process, lactic bacteria of the ecosystem can produce high concentrations of lactic acid, which reduce or inhibit the growth of putrefactive microorganisms, sensitive to low pH, and, consequently, facilitate conservation of the silage. Further studies are needed for confirming these aspects.

Silage contains around 11 and 13 % of ashes, which evidences the presence of minerals like calcium and phosphorous, determined in this study in samples from the industrial plant. Its organic matter (DM-ashes) was superior to 85 %, with a content of 21.00 % of total soluble solids (table 1). Nutrients of this fraction can be used by microbial populations that take part of the silage. This aspect was not controlled and has to be considered in further researches for deepening on the silage characteristics and, maybe, increase productive yields and efficiency.

Table 1. Chemical characterization of the sweet potato silage, obtained under laboratory conditions

Indicators	Mean (n=3)	SD	CV, %
DM, %	33.75	1.10	3.27
Ashes , %	11.17	0.46	4.09
CP, % DB	9.66	0.64	6.60
CF, % DB	2.21	0.25	11.26
pH	3.78	0.04	0.95
º Brix	21.00	0.00	0.00

n: Number of samples
SD: Standard deviation
CV: Coefficient of variation
DB: Dry basis

Table 2. Chemical characterization of the sweet potato silage, produced in the food factory "Héctor Molina", Mayabeque, Cuba

Indicators	n	Mean	SD	CV, %
DM, %	23	24.63	1.82	7.41
Ashes, %	23	13.96	0.73	5.22
CP, % DB	22	11.15	1.65	14.76
CF, % DB	21	2.92	1.36	46.54
Calcium, %	12	1.58	0.25	15.84
Phosphorous, %	12	0.25	0.03	12.67
pH	23	3.61	0.02	0.67

n: Number of samples
SD: Standard deviation
CV: Coefficient of variation
DB: Dry basis

According to the results, it is considered that ensiled food of sweet potato has proper chemical characteristics for its use as alternative feeding of pigs.

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