



Vinasse in the diet of lactating sows and its effect on litter

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ABSTRACT. The aim of this study was to verify the impact of adding vinasse as an acidifier in sows diet during the lactating period and its effect on litter. A total of 14 agroceres females were used from the first day of lactation until weaning. The vinasse was obtained in a mill near the experimental facility and was stored in sterilized barrels. Animals were distributed in a completely randomized experimental design into two treatments: control liquid diet and liquid diet with the inclusion of vinasse in each feed supply of the day. The diets were supplied four times a day, containing a mixture of ½ L of vinasse and ½ L of water. Feed leftovers were weighted daily. Feed intake was used to evaluate sows' performance. The piglets were weighted every week after birth until weaning in order to obtain weight gain. Vinasse inclusion showed an increase ($p < 0.05$) in feed intake of lactating sows, improving diet palatability. Inclusion of acidifier in the diet did not show ($p > 0.05$) difference in weight gain of piglets. Vinasse consumption by sows did not influence litter performance. The inclusion of vinasse in the diet of lactating sows is beneficial because increases feed consumption.

Keywords: acidifiers; sows; progeny; sugarcane stillage.

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Introduction

Gestation and lactation can be considered determinant to improve productivity and profitability of the pig chain between all production stages. The growth potential of piglets in the first weeks of life can be affected by the low milk yield of the sows, which does not satisfy the energy demand of newborns (Padilha, Groff, Turmina, & Teixeira, 2017) and can also affect weaning weight, and have an impact on age, slaughter weight and amount of feed consumed.

Low milk intake is also linked to the vulnerability of piglets to respiratory and nutritional diseases and increase in litter mortality, which is prejudicial for farm productivity (Verussa et al., 2017). It is possible to improve litter performance by making changes in female diets, especially at the end of pregnancy and lactation, given the importance of feeding for milk production and piglet development (Verdon & Hemsworth, 2016).

According to Li (2017) the use of growth promoters additives in animal nutrition such as antibiotics is in disuse. The use of alternative additives becomes a reality in animal production because society is worried about the possible harmful effects on human health, environmental contamination and bacteria resistance.

Natural or herbal additives works to improve performance in an effectively and economical way. They are used in small amounts and are neither toxic nor harmful to the environment. Several studies have shown that animals receiving organic acids, enzymes, symbiotics, prebiotics and phytogenic additives when added to feed, can achieve a performance similar when receiving antibiotics as growth promoters (Namkung et al., 2004; Mair et al., 2010; Dowarah & Verma, 2017).

According to Viola and Vieira (2007) acidifiers works as an alternative because they can improve animal performance, besides having similar effects as antibiotics, which are beneficial to the intestinal morphology of animals. The use of sugarcane by-products, such as yeast, vinasse, filter cake, sugarcane tip and bagasse, has been studied by several researchers (Sarmiento et al., 1999; Hidalgo et al., 2009; Patiño et al., 2012).

Co-products are forwarded to industries such as animal feed manufacturers. The fractional distillation of fermented sugarcane juice to obtain ethanol results in a pasty residue called Vinasse (Neves & Conejero, 2007).

Alves, Fernandes, Guidastre, Costa and Ferreira (2019) reported that for each liter of alcohol produced, 12 liters of vinasse are left as waste, which is generally used as bio fertilizer.

The objective of this study was to verify the effects of adding vinasse as an acidifier in sows' diet on performance and its effects on piglets development from the initial phase until weaning.

Material and methods

The experiment was carried out at the Swine Farm of the Federal Institute of Minas Gerais-Campus Bambuí-MG. Fourteen Agroceres Camborough sows with similar calving orders, inseminated by Biribas BM500 breeder and fed with liquid diet were used. The experiment was composed by two treatments: control group, receiving feed and water and treatment group, with the inclusion of vinasse next to the water on diet. The animals were distributed in a completely randomized experimental design of two treatments with 7 replicates per treatment. Each sow was considered an experimental unit.

Vinasse bromatological composition, based on dry matter, was 12.1% crude protein, 6.6% mineral matter, 0.5% calcium, 0.24% phosphorus, 1.6% potassium. 0.08% sodium, dry matter content is 2.46%. The performance of the newly calved females was observed during lactation period and litter's performance was analyzed until weaning (30 days). Vinasse was obtained at Bambui Bioenergia Mill and was stored in sterilized barrels. In order to analyse the acidifying effect of vinasse in the diet, some analyzes were conducted to verify the pH of the vinasse itself and the pH of the diet supplied without the additive and after the inclusion of the additive in the diet of lactating sows.

Analyzes were performed at the Bromatology and Animal Nutrition Laboratory of the campus, according Park and Antônio (2006) methodology. Digital Lab bench microprocessor, model DLA - pH Del Lab, previously calibrated according to the manufacturer's recommendations were used for pH measurement. The vial containing 1/10 of vinasse solution and distilled water was closed and shaken for approximately 5 seconds. The electrode was then put into the solution and the pH was collected once the pHmeter value stabilized.

Sows' liquid diet was supplied four times a day (1,500kg each), including the mixture ½ L of vinasse to ½ L of water - 50% of the liquid part was mixed in the diet. Feed leftovers were weighed daily to obtain feed intake.

The animals used in the experiment were females with similar ages, weights, and calving orders. The piglets evaluated were from the female under evaluation without batch management per weight, sex or piglet size. The piglets were weighed at birth and at weaning to obtain the final litter weight.

Diet used in lactation phase was formulated according to Rostagno et al. (2017) recommendations and the feed composition are presented in table 1.

Table 1. Composition of lactating sows diet.

Ingredients	Amount (A)
Corn	62,00
Soybean meal	24,00
Wheat bran	6,00
Sugar	4,00
Vitamin-mineral supplement *	4,00
Total	100

*Vitamin-mineral supplement composition: Calcium (max.) 200 g; Calcium (min.) 160 g; Phosphorus (min.) 30 g; Sodium (min.) 55 g; Vitamin A (min.) 200.000 UI; Vitamin D3 (min.) 20.000 UI; Vitamin E (min.) 300 UI; Vitamin K3 (min.) 50 mg; Vitamin B1 (min.) 40 mg; Vitamin B2 (min.) 30 mg; Vitamin B6 (min.) 40 mg; Vitamin B12 (min.) 450 mcg; Pantothenic acid (min.) 250 mg; Niacin (min.) 650 mg; Folic acid (min.) 25 mg; Biotin (min.) 6.000 mg; Iron (min.) 2000 mg; Copper (min.) 1.500 mg; Cobalt (min.) 30 g; Iodine (min.) 25 mg; Manganese (min.) 1000 mg; Zinc (min.) 2.400 mg; Selenium (min.) 7 mg; phytase 12.500 ftu.

Feed intake with or without the inclusion of vinasse was used to evaluate sows' performance being the average of the daily diet supplied discounting the leftovers. For piglets, the average piglet weight (PW) was evaluated, being the final weight in the maternity phase, and the daily weight gain of the piglet (WG) during the maternity phase (kg), resulting from the difference in weight of animals at birth and at the end of the maternity phase divided by the total period of this phase (30 days).

The evaluated parameters were submitted to analysis of variance with 5% probability using the LM function - Stats package of the R statistical program (R CORE TEAM, 2017). Means were compared by Tukey with the HSD - test function - agricultural package of the R statistical program.

Results and discussion

The pH analysis results of vinasse and experimental diet are presented in table 2.

Table 2. pH analysis of vinasse and experimental diets.

Parameters	Means
Control feed (without vinasse) (T1)	6.44*
Feed containing vinasse (T2)	5.96*
Liquid Vinasse	4.05*

*Descriptive analysis.

It can be observed that the inclusion of vinasse as an acidifier decreased the pH of the diet with addition of 0.48%. According to Hidalgo et al. (2009) the inclusion of up to 2% of vinasse in swine feed have great benefits, because it is rich in organic acids, which improve nutrient utilization and digestion, and will also influence in weight gain of animals.

By using the analysis of variance in treatments (with and without inclusion of vinasse), it was possible to observe a significant difference in feed intake ($p = 0.00067414$) and a coefficient of variation of 10.06%.

Mean values of sows' feed intake receiving different diets during lactation period are shown in Figure 1.

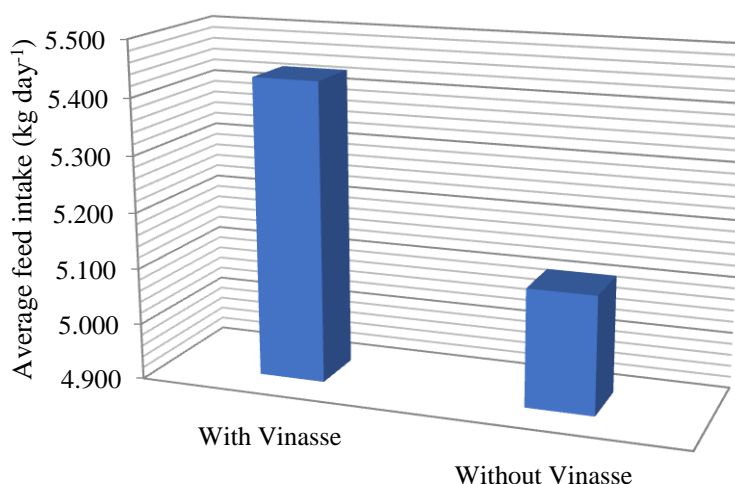


Figure 1. Mean values of average feed intake (kg day⁻¹) of lactating sows diets by Tukey test ($p < 0.05$).

Tukey test ($p < 0.05$) shows that sows receiving the diet containing vinasse had higher consumption values (5.432 kg day⁻¹) when compared to the control diet (5.109 kg day⁻¹), showing that the animals did not reject the feed containing acidifier.

The higher feed consumption by sows, observed in feed where the vinasse was included, is due to the improvement in palatability. Kluge et al. (2006) verified better feed intake and feed conversion in pigs using organic acids in feed. According to Miguel (2011) the use up to 1.0% of acidifiers in piglet's diet results in higher feed intake by animals, and greater weight gain. Rego et al. (2012), did not found differences in feed intake when using acidifiers. Different results found by the authors can be explained by the fact that the action of acidifiers can differ depending on factors related to animals and the feed supplied to them.

There are several hypotheses about acidifiers mechanisms of action and the most known are: gastric pH reduction and dietary buffering capacity, changes on intestinal microbiota due to bactericidal or bacteriostatic control, reduction in the rate of stomachs emptying, higher enzymatic activity, higher proteolysis and nutrient digestibility, stimulation of pancreatic secretions, and lower intestinal morphological changes (Denck, Hilgemberg, & Lehnen, 2017).

No significant difference ($p = 0.5160$) was observed in the analysis results for treatment effect (with or without inclusion of vinasse in the diet of lactating sows) for the parameter piglet weight (kg), with a coefficient of variation of 13.78%. Means of piglet weight values for different diets of lactating sows are shown in Figure 2.

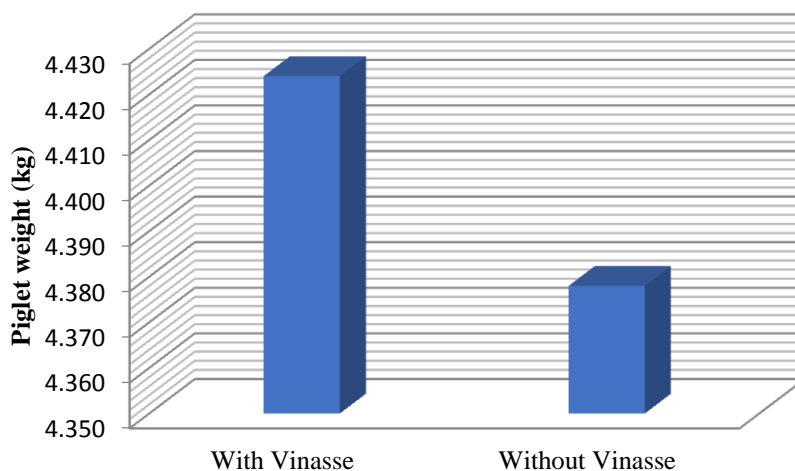


Figure 2. Mean values of piglet weight by Tukey test ($p > 0.05$).

Inclusion of vinasse resulted in similar values for weight of piglets (4.424 kg) compared to the diet without inclusion of vinasse (4.378 kg), which shows that feed consumption by the sows did neither directly affect milk production nor daily weight gain of piglets. According to Gong, Yin, Hou, & Yin (2014), in good conditions for piglets performance, such as good sow condition, use of complex diets, low sanitary challenge, correct management and environment, it is hard for an additive to provide beneficial effects.

There was no difference ($p < 0.05$) between the treatments used for weight gain of piglets (Table 3).

Table 3. Weight gain of piglets, grams per day (WG / g / piglet / day) and mortality (%) in maternity phase, from sows receiving diet containing vinasse.

Parameters	Control feed	Feed with vinasse	CV	P-value
WG/g/piglet/day	207.5	4.56	3.76	0.0590
Mortality (%) *	206.2	4.88	-	-

CV: Coefficiente of variation; *Descriptive analysis.

Weight gain is linked to factors such as genetics and size at birth. According to Pissinin (2016) the average of biological capacity growth of piglets with high genetic potential, from birth to 21 days old, is at least 350 g day^{-1} . Fix et al. (2010) observed that piglets which born heavier are going to be weaned heavier.

Another possible limiting factor for similar litter performance may have been sow's milk production. According to Boyd et al. (1995) sow's milk production only meets 50% of the needs of 10 piglets at 21 days of age. A sow should produce 18 to 20 kg of milk per day to attend all piglets at 21 days of lactation. Due to the higher intensity of breastfeeding, sows with larger number of piglets produces a larger volume of total milk, but milk production itself decreases. However, milk production capacity reaches a maximum limit at the end of lactation and is less influenced by the number of suckling piglets (Auld et al., 1998).

The voluntary feed intake of gilt and sows during lactation is often insufficient to meet their nutritional requirements for maintenance, milk production and body growth.

Hidalgo (2009) reported that the addition of up to 2% of vinasse in swine feed ensures a higher final weight of the animals, reduces expenses with enteric disease medicines, helps to attend calcium, magnesium, sodium, iron and chlorides demands and contributes with sexual maturity in reproduction. In addition of avoiding the spread of pathogens, is useful to improve palatable factors and feed conversion, digestion, nutrient utilization, vitamin and mineral synthesis, and intestinal microbiota balance.

The results obtained in this experiment shows the necessity of further studies to better understand the direct influence of using additives in sows diet and how this will change or not the production and composition of milk and weight gain of piglets; because a large number of researches studies are conducted in the nursery phase in which the needs and benefits of using organic acids are already known.

In general, the inclusion of vinasse as an acidifier for lactating sows is beneficial, because increases voluntary consumption, which can help avoiding the loss of weight and production in females during lactation phase, and also solves problems with the disposal of industrial waste.

Conclusion

The inclusion of vinasse in the diet of lactating sows increased the feed intake and had no significant effects on piglets weaning weight. The consumption of vinasse by the sows had no influence on the performance of the litter.

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