FEED INTAKE AND RUMINAL PARAMETERS OF MILKING DAIRY CALVES SUPPLEMENTED WITH DIFFERENT ADDITIVES: A META-ANALYSIS

ALINE BIANCA BERVIAN[1]; MELINA CALEGARO TAMIOZZO[2]; VERLISE LUCENA ROQUE DA SILVA[2]; JÚLIA SCHELLIN CAVALHEIRO[2]; GIOVANI FIORENTINI[2]; CARLA JOICE HÄRTER[3].

[1]Federal University of Pelotas – abbervian@gmail.com
[2]Federal University of Pelotas – tamiozzo.melina@gmail.com; verliselrs@gmail.com; julia_cavalheiro14@hotmail.com; fiorentini.giovani@gmail.com
[3]Federal University of Pelotas – harter.carla@gmail.com

1. INTRODUCTION

4Dairy calves are very important in a dairy farm because the genetic and reproductive herd improvement is based on the replacement of old cow for new ones, therefore a good calve breeding is the first step for the farm success (BRUM, 2006). As long as profitability has been decreased and feeding is one of more expensive cost in the propriety, mostly in the first few months of life, there is an attempt to reduce costs and improve performance since its birth (CASIMIRO et al., 2012).

From birth to weaned, calves pass through physiological and metabolic big changes as they devolve from pre ruminant, a metabolism very similar as monogastric, to ruminants (ANJOS, 2017). They need to have access to water and palatable concentrate and so it will start the rumen development (ZANOTTI, 2013). Therefore, this phase requires efficient and careful management practices and a very good nutrition to develop the rumen, reducing costs and improving future performance (ANJOS, 2017; CASIMIRO et al., 2012; ZANOTTI, 2013).

For calf producers be successful, they need to find out a method to have heifers breeding weight as soon as possible so they will calve sooner and have fewer time of non-productive phase (LABORDE, 2008). In this sense, feed additives could improve feed efficiency, average daily gain, daily feed intake, gastrointestinal health benefits as well as prevent possible infections in the first calf phases, enhancing female performance and cheapening breeding expenses (CASIMIRO et al., 2012; BRUM, 2006; LABORDE, 2008). In addition, additives non-antimicrobial are an option to reduce future antibiotic-resistance, improving performance and minimizing pathogenic bacteria colonization in digestive tract (GALVÃO et al., 2005). As well, milk replacer could be an option to decrease costs, letting milk obtained in the system for marketing, and ensuring the intake of all nutrients necessary for the better development of calves (ZANOTTI, 2013).

As studies around calves and the additive uses for this phase are still limited and sometimes conflicting conclusions, this meta-analysis aimed to investigate the effect of different additives and type of liquid diet in some dairy calf parameters throughout suckling phase.

2. MATERIAL AND METHODS

This study is a meta-analysis in which the effect of different additives and different type of liquid diet (raw milk or milk replacer) on various suckling calf ruminal parameters (acetate, butyrate and propionate concentration), dry matter intake (DMI), concentrate intake, ruminal pH and total volatile fatty acids (VFAs). For this, were utilized seventy-seven articles published in peer-reviewed journals with dairy calves supplemented with

YEASTS (live yeast by *Saccharomyces cerevisiae spp.*), PRE (fermentation products by *Saccharomyces cerevisiae spp.*), LAB (lactic acid bacteria) and MIX (mixture of the previous additives).

The meta-analysis was performed as mixed models, using the MIXED procedure of SAS, where the random effect of the study was included on the model by RANDOM statement and weighting for averages weight was include by WEIGHT statement. Significance was declared at p<0.05 by Fisher's test.

3. RESULTS AND DISCUSSION

Variables according different treats and liquid diet type results of this search are shown in Table 1. It was found increasing in DMI by milk replacer group. Levels of acetate were higher calves receiving MIX, PRE, YEAST and RM group. Butyrate was higher calves receiving LAB, MIX, PRE, CONTROL and raw milk treatments. Propionate has lower level in CONTROL. The concentrate intake (CI) increased only when treatment with LAB.

Table 1: Intake and ruminal and parameters of dairy calves supplemented with different additives and liquid diet.

Treatment/ Liquid diet**		Variables						
		Acetate mmol/L ±SEM[1]	Butyrate mmol/L ±SEM	Prop[2] mmol/L ±SEM	DMI[2] Kg/d ±SEM	CI[3] Kg/DM ±SEM	Ruminal pH ±SEM	Total VFAs[4] mmol/L ±SEM
LAB		42.9 $\pm3.96^{b}$	6.66 $\pm 0.59^{a}$	32.4 $\pm 7.34^{a}$	1.12 ±0.071	0.79 $\pm0.06^{a}$	5.52 ±0.27	78.2 ±24.9
MIX		46.8 $\pm3.89^{a}$	5.63 $\pm0.58^{a}$	31.7 $\pm 7.35^{ab}$	1.11 ± 0.076	0.617 $\pm0.06^{b}$	5.87 ± 0.21	81.9 ± 26.3
PRE		46.4 $\pm4.02^{a}$	6.7 $\pm0.84^{a}$	31.6 $\pm7.45^{a}$	1.11 ±0.068	0.64 $\pm0.06^{b}$	5.95 ±0.22	81.4 ±26.9
YEASTS		45.9 $\pm3.80^{a}$	3.75 $\pm0.60^{b}$	31.8 $\pm7.29^{a}$	1.17 ±0.072	0.64 $\pm0.08^{b}$	5.94 ±0.20	73.3 ±22.7
CONTROL		44.9 $\pm3.80^{b}$	5.61 $\pm0.40^{a}$	29.8 $\pm7.28^{b}$	1.09 ±0.066	0.59 $\pm0.05^{b}$	5.9 ±0.20	73.5 ±22.7
MR		30.2 $\pm5.33^{b}$	3.9 $\pm0.45^{b}$	18.5 ±10.25	1.33 $\pm0.086^{a}$	0.63 ±0.05	6.09 ±0.30	59.1 ±36.0
RM		60.5 $\pm5.37^{a}$	7.44 $\pm0.59^{a}$	44.5 ±10.32	0.91 $\pm0.099^{b}$	0.68 ±0.06	5.58 ±0.27	96.3 ±25.0
P-value	Treat[5]	0.0048	0.0443	0.0037	0.0698	<0001	0.334	0.583
	Milk	0.0039	0.0017	0.111	0.0033	0.321	0.232	0.429
Sigma	Study	84.5	0.413	314.4	0.0734	0.0734	0.353	2689.2
	Resi[6]	0.125	0.505	0.436	0.014	0.014	0.00219	0.101

[a-b] Means in the same column with different superscripts differed significantly (Fisher's test; $P < 0.05$).

[1]SEM= Standard Error of the Mean; [2]DMI= Dry Matter Intake; [2]CI= Concentrate Intake; [4]VFAs= Volatile Fatty Acids; [5]TREAT= Treatment.; [6]Resi= Residual

**LAB= Lactic Acid Bacteria; MIX= mixture of the previous additives; PRE= fermentation products by Saccharomyces cerevisiae spp.; YEASTS= live yeast by Saccharomyces cerevisiae spp; MR= Milk Replacer; RM= Raw Milk

Concentration of ruminal acetate was increased 4% by MIX and 2% by YEASTS comparing with control group and decreased 5% by LAB. Propionate concentration was increased 6% by MIX and YEASTS, and 8% by LAB compared to control. Butyrate concentration was lower in the group supplemented with YEASTS than in the other treatments. Calves supplemented with PRE had higher concentrations of acetate (3%), butyrate (19%) and propionate (6%) compared to control. Produce ratio of each VFA depends on bacterial specie, which can be specialized in one kind of acid, and the bacterial predominance is determined by diet. Therefore, some additives stimulating Positive Gram bacterial as other stimulating Negative Gram bacteria and consequently there is more produce of one kind of volatile acid (KOZLOSKI, 2016). There was no total VFAs statistical difference between treatments.

Some yeast structures are important for microbial fermentation (OEZTUERK et al., 2005) explaining the elevation of some acids in different treats as stimulation of DMI (PINOS-RODRÍGUEZ et al., 2008). However, results of the current study did not show any DMI increase with additive supplementation, maybe due to the different responses depending on supplementation method, strain of yeast supplemented and diet composition (PINOS-RODRÍGUEZ, 2008).

Even if most part of studies shown health improvement and just few of them found a higher performance when calves are supplemented with probiotics (FRIZZO et al, 2010), in this current study only LAB supplementation increased CI in 33% more than control. This higher CI is important to allow earlier weaning and improving ruminal and general performance (FRIZZO et al, 2010).

Comparing liquid diet supply, calves feeding with milk replacer had lower levels of acetate and butyrate (50% and 48%, respectively) than raw milk feeding. Milk replacer improved 46% DMI compared to row milk. Higher intake of liquid diet could reduce concentrate intake (COWLES et al., 2006), but it was not observed in this study, otherwise it could explain the higher levels of acetate and butyrate in row milk, as calves found in concentrate carbohydrate and fiber, both important to produce VFAs (COWLES et al., 2006). It was no difference in propionate concentrations, total VFAs nor ruminal pH between both liquid diets.

4. CONCLUSION

Calves consuming milk replacer had higher DMI than those consuming raw milk and the best results were with lactic acid bacteria supplementation rather than the other ones. So, add LAC in MR can be an option to optimize dry matter and concentrate intake, possibly improving calve performances.

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