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EFFECTS OF DIETS WITH INACTIVE DRY YEAST ADDITION ON PRODUCTIVITY AND HEALTH STATUS IN DAIRY COWS

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Abstract

This study evaluated the influence of inactive dry yeast in diets of dairy cows on productivity, blood-urine parameters, and faecal score. The research was carried out on a number of 30 Romanian Black and Spotted lactating dairy cows, with 583±16.99 kg live weight, divided into three groups (n=10), two experimental E_1 and E_2 groups, and one control group (C). The experimental group E_1 received 120g inactive dry yeast/head/day, while the experimental group E_2 received 150g inactive dry yeast/head/day during a 28 days trial. Dietary treatment effects were determined using analysis of variance (ANOVA) for repeated measures (mixed model). Supplementation of the diet with inactive dry yeast generated an increase of milk yield ($P<0.10$) for the E_1 and the E_2 groups, compared with the C group. For the milk lactose percentage, a treatment influence ($P<0.05$) and period influence ($P<0.10$) between the studied groups were observed. Also, for some blood indicators, a dietary treatment influence was recorded. There were no significant effects of the treatments on the other studied parameters. Dry yeast addition in dairy cows diets can have a positive effect on milk yield performance.

Key words*: dairy cows, dry yeast, health, productivity.*

INTRODUCTION

Using yeasts as feed additives for ruminants represents a global trend, with a high number of body literature showing beneficial positive effects on productive parameters (Amin & Mao, 2021). Therefore, yeasts (*Saccharomyces cerevisiae* sp.) through their high nutrient content, represent a potential feed resource that can be used in dairy cows diets, to optimize the structure of the concentrates. Yeasts promote livestock productivity, being beneficial to animal health and are being used as ruminal enhancer (Lopreiato et al., 2020; Faccio-Demarco et al., 2019). In the rumen, yeasts can utilize the remaining dissolved oxygen, protecting anaerobic microbes from the damaging effects of oxygen. Yeasts can increase rumen motility and regulate ruminal pH, minimizing the danger of acidosis in dairy cattle (Chaucheyras-Durand et al., 2016). Yeasts improve cattle feed digestion and metabolism in a variety of ways, including increasing nutritional digestibility, optimizing volatile fatty acid proportions, decreasing ammonia–nitrogen levels, lowering pH fluctuation, and stimulating microbial communities in the rumen (Cagle et al., 2020; Perdomo et al., 2020; Dias et al., 2018a). In ruminants, the beneficial effects of yeasts as microbial feed additives are represented by better ruminal digestion, improved nutrient utilization, higher feed intake, improved milk yields and weight gains (Ogunade et al., 2019; Habeeb, 2017; Sartori et al., 2017). The aim of this study was to evaluate the influence of inactive dry yeast in the diets of dairy cows on productivity, blood-urine parameters and faecal score.

MATERIALS AND METHODS

The study was carried out at the Experimental Farm of the Research and Development Institute for Bovine Balotesti (44°36′46″N 26°4′43″E), Romania, in accordance with the *Romanian Law no. 43/2014* and the *Council Directive 2010/63/EU* on the protection and handling of animals used for scientific purposes. The design trial used 30 multiparous Romanian Black and Spotted dairy cows, clinically healthy, that were divided in three homogenous groups (n = 10/group), balanced for age, milk yield and body weight (group C: 5.6 years old, 18 kg of milk/day/head, 600 live

weight; group E_1: 5 years old, 18 kg of milk/day/head, 590 live weight; group E_2: 5 years old, 18 kg of milk/day/head, 560 live weight). Diets were supplemented with either 0 g inactive dry yeast/head/day (C), 120 g inactive dry yeast/head/day (E_1) and 150 g inactive dry yeast/head/day (E_2) for 28 days. The inactive dry yeast used in this study was procured from certified suppliers. The cows were housed in a tie-stall stanchion barn. The diet consisted of 6 kg alfalfa hay, 25 kg corn silage, and 6 kg concentrates/head/day. Cows had mineral licks and water available for *ad libitum* consumption. The nutritional value of the analyzed feeds and the nutrient composition of the diets used in the study are presented in Tables 1 and 2.

Table 1. The nutritional value of the feeds used during the trial (g/kg forage)

Nutritive crude value	DM, kg	MNU	DIPN, g	DIPE, g	Ca, g	P, g
Alfalfa hay	0.87	0.69	106	82	10	1.9
Corn silage	0.26	0.21	13	17	1.2	0.5
Concentrates	0.90	1.00	120	82	9.6	6.9
Dry yeast	0.90	1.05	315	178	5.3	16

DM=dry mater; MNU=milk nutrition units; DIPN=digestible intestine protein allowed by the nitrogen content of the fodder; DIPE=digestible intestine protein allowed by the energy content of the fodder; Ca=calcium; P=phosphorus.

Table 2. The diet used during the trial

Feed	kg	15-18 DM, kg	13-15 MNU	1200-1350 DIPN, g	1200-1350 DIPE, g	90 Ca, g	54-60 P, g
Alfalfa hay	6	5.22	4.14	636	492	60.0	11.40
Corn silage	25	6.50	5.25	325	425	7.2	12.50
Basic ratio input	**31.00**	**11.72**	**9.39**	**961**	**917**	**67.2**	**23.9**
Concentrates	6.0	5.40	6	720	492	57.60	41.40
Total basic ratio input (C)	**37.00**	**17.12**	**15.39**	**1.681**	**1.409**	**124.80**	**65.30**
Inactive dry yeast	0.12	0.11	0.13	36.60	21.36	0.64	1.92
Total (C + E_1)	**37.12**	**17.23**	**15.52**	**1717.60**	**1430.36**	**125.44**	**67.22**
Inactive dry yeast	0.15	0.14	0.16	47.25	26.70	0.80	2.40
Total (C + E_2)	**37.15**	**17.26**	**15.55**	**1728.25**	**1435.70**	**125.60**	**67.70**

C=diet supplemented with 0 g inactive dry yeast/had/day; E_1=diet supplemented with 120 g inactive dry yeast/had/day; E_2=diet supplemented with 150 g inactive dry yeast/had/day; DM=dry mater; MNU=milk nutrition units; DIPN=digestible intestine protein allowed by the nitrogen content of the fodder; DIPE=digestible intestine protein allowed by the energy content of the fodder; Ca=calcium; P=phosphorus.

Cows were fed and milked twice daily (5AM and 5PM). The assessment of the productive performances and health status of the animals used in this study, such as milk yield, milk composition (fat %, protein %, lactose %), hematological, serum biochemical and urinary parameters were performed. Milk samples (30 ml) were collected during morning and evening milking before feeding and kept at 4°C for analysis. The milk composition was evaluated using the Ekomilk 120 ultrasonic analyzer. The milk/blood/urinary samples and faecal score were evaluated at following intervals: day 0 (start of the trial), at 12 days, and 28 days, for all three treatments. The Abacus Junior Vet 5 automatic analyzer was used for performing hematological examinations (red blood cells, hemoglobin, hematocrit, total white blood cells, lymphocytes, monocytes, neutrophils). The serum biochemical parameters (total proteins, asparagine aminotransferase, alkaline phosphatase, total calcium, inorganic phosphorus) were analyzed using a semiautomated biochemical analyzer StarDust MC 15.

Urine samples were collected in 50 ml sterilized vials, as free catch during micturition. Urine examination, with the following parameters: bilirubin, urobilinogen, ketones, ascorbic acid, glucose, protein, blood, pH, nitrites, leukocytes and specific gravity, were determined with the DocUReader urine analyzer. Evaluation of the faeces was performed on the basis of a scale numbered from 1 to 5, taking into account the '3C': colour, consistency and content, before the morning feeding. Results were expressed as a mean (± standard error of the mean). Dietary treatment effects were determined using analysis of variance

(ANOVA) for repeated measures mixed model. The statistical model was:

$$Y_{ijk} = \mu + T_i + P_j + C_k + (T \times P)_{ij} + e_{ijk}$$

where: Y_{ijk}=dependent variable; μ=overall mean; T_i=effect of treatment i (fixed effect); P_j=effect of time j (fixed effect); C_k=effect of animal k (random effect); $(T \times P)_{ij}$= interaction treatment i and time j; e_{ijk}=residual error term. Significance level was considered when P≤0.05 and trends when P<0.10.

RESULTS AND DISCUSSIONS

The studied animals had an average daily consumption (depending on the treatments), between 17.12-17.26 kg DM/kg, 15.39-15.55 MNU, 1681-1728.25 g PDIN, 1409-1434.70 g PDIE, 124.80-125.60 g Ca, and 65.30-67.70 g P, values that fall within the standard norms in relation to body weight and milk production (Table 3).

Table 3. The average daily intake of the dairy cow's diets

Season/Group	DM, kg	MNU	PDIN, g	PDIE, g	Ca, g	P, g
C	17.12	15.39	1681	1409	124.80	65.30
E_1	17.23	15.52	1717.60	1430.30	125.44	67.22
E_2	17.26	15.55	1728.25	1435.70	125.60	67.70

Note: C=diet supplemented with 0 g inactive dry yeast/had/day; E_1=diet supplemented with 120 g inactive dry yeast /had/day; E_2=diet supplemented with 150 g inactive dry yeast/had/day. DM=dry mater; UNL=milk nutrition units; PDIN=digestible intestine protein allowed by the nitrogen content of the fodder; PDIE=digestible intestine protein allowed by the energy content of the fodder; Ca=calcium; P=phosphorus.

During the studied period, supplemental dry yeast tended to influence milk yield (C 15.75 kg vs. E_1 18.15 kg vs. E_2 16.51 kg, SEM=0.415, P=0.078), results are being presented in Table 4. Interactions between dietary treatment x period for milk yield, milk fat, and milk protein were not found (P=0.529). However, for lactose percentage, an influence for treatment (P=0.042) and period (P=0.079) among the studied groups were observed. Many research studies showed that supplementation of lactating cows diets with yeasts improved milk yield, milk lactose, milk protein and health status (Enculescu, 2021; Zhu et al., 2017). On the contrary, research published by Fereira, 2019 and Ambriz-Vilchis et al., 2017 found no effects of yeasts administration on performances and health.

Table 4. Effects of inactive dry yeast on milk yield and milk composition in lactating dairy cows

Parameters	Treatment			SEM	Effect*		
	C	E_1	E_2		T	P	(T x P)
Milk yield, kg/day	15.75	18.15	16.51	0.415	**0.078**	0.154	0.529
Fat, %	4.58	4.68	4.62	0.080	0.823	0.159	0.201
Protein, %	3.35	3.36	3.27	0.029	0.410	0.109	0.689
Lactose, %	4.22	4.59	4.28	0.045	**0.042**	**0.079**	0.207

C=diet supplemented with 0 g inactive dry yeast/had/day; E_1=diet supplemented with 120 g inactive dry yeast/had/day; E_2=diet supplemented with 150 g inactive dry yeast/had/day; SEM=standard error of the mean; Effect*: T=treatment; P=period; TxP=interaction between treatment x period.

Moreover, an important aspect was to evaluate the effects of inactive dry yeast addition in the diets on the health status of cows. During our trial, tendencies for treatment influence between the E_1, E_2 and the C groups for HTC (P=0.078), WBC (P=0.092), MO (P=0.060) were observed (Table 5). The effect of the period (P) on dietary treatments was observed for HGB (P=0.028), HTC (P=0.005), WBC (P=0.039), LY (P=0.001), MO (P=0.000) and NE (P=0.000).

Furthermore, an interaction between dietary treatment x period for concentrations of HTC was detected (P=0.093).

Table 5. Effects of inactive dry yeast on haematological and biochemical parameters in lactating dairy cows

	Treatment			SEM	Effect*		
Parameters	**C**	**E_1**	**E_2**		**T**	**P**	**(T x P)**
RBC, 10^6/µl	6.46	6.14	6.08	0.121	0.380	0.375	0.407
HGB, g/dl	9.42	9.46	9.22	0.073	0.637	**0.001**	0.225
HCT, %	26.74	28.58	29.26	0.366	**0.078**	**0.005**	**0.093**
WBC, 10^3/µl	8.41	7.42	8.24	0.305	**0.092**	**0.039**	0.535
LY, %	58.37	59.89	58.06	0.565	0.717	**0.028**	0.297
MO,%	4.49	4.12	6.18	0.634	**0.060**	**0.000**	0.301
NE, %	37.62	35.06	34.64	0.931	0.442	**0.000**	0.283
Proteins, mg/dl	7.32	7.64	7.97	0.162	0.191	**0.072**	0.185
AST, U/L	47.10	45.06	43.73	1.477	0.291	0.654	0.792
ALP, U/L	76.83	74.84	67.56	2.497	**0.060**	0.260	0.129
Ca, mg/dl	8.39	8.69	8.79	0.120	0.244	0.653	0.722
P, mg/dl	4.32	4.63	4.57	0.095	0.430	**0.085**	0.981

C=diet supplemented with 0 g inactive dry yeast/had/day; E_1=diet supplemented with 120 g inactive dry yeast/had/day; E_2=diet supplemented with 150 g inactive dry yeast/had/day; SEM=standard error of the mean; Effect*: T=treatment; P=period; TxP=interaction between treatment x period; RBC=red blood cells; HGB=haemoglobin; HCT=hematocrit; WBC=total white blood cells; LY=lymphocytes; MO=monocytes; NE=neutrophils; AST=asparagine aminotransferase; ALP=alkaline phosphatase; Ca=total calcium; P=inorganic phosphorus.

Total protein was not affected by the addition of dry yeast (P=0.191). However, a tendency for period effect was observed (P=0.072). Concerning the enzymatic profile, the activity of the AST (47.10 U/L vs. 45.06 U/L vs. 43.73 U/L, SEM=1.477, P=0.291) was not influenced by the dry yeast addition. Dietary supplementation with dry yeast tended to reduce the activity of ALP (76.83 U/L vs. 74.84 U/L vs. 67.56 U/L, SEM=2.497, P=0.060), which suggests the involvement of the yeast in promoting intestinal metabolism and regenerating the liver tissue.

Also, the mineral profile (Ca, P) was not affected by dry yeast supplementation, nevertheless, a tendency for the period effect (P=0.085) was detected. The results of the overall urinary examination during the studied period are presented in Table 6. The urinalysis indicated that none of the dietary treatments had any effects on the parameters studied. Most parameters analyzed during the studied period (d 28) were negative. For urine proteins, values of 15-30 mg/dl (E_1, E_2), and respectively 30-100 mg/dl (C), were recorded.

Table 6. The results of the overall urinary examination during the study period

	Treatment		
Parameters	**C**	**E_1**	**E_2**
Bilirubin, mg/dl	Negative	Negative	Negative
Urobilinogen, mg/dl	Normally	Normally	Normally
Ketones, mg/dl	Negative	Negative	Negative
Glucose, mg/dl	Negative	Negative	Negative
Protein, mg/dl	15-100	15-30	30
Blood, ery/µl	Negative	Negative	Negative
PH	5-7	5-7	6-8
Nitrite	Negative	Negative	Negative
Leukocytes, leu/µl	Negative	Negative	Negative
Specific gravity	1.010-1.025	1.010-1.025	1.010-1.025

C=diet supplemented with 0 g inactive dry yeast/had/day; E_1=diet supplemented with 120 g inactive dry yeast/had/day; E_2=diet supplemented with 150 g inactive dry yeast/had/day.

Generally, in lactating dairy cattle values of up to 15 mg/dL are indicated. Pathological causes of proteinuria (presence of protein in urine) could indicate renal disease, urinary tract infections and haematuria (Enculescu et al., 2020). Overall intervals for specific gravity were 1.010 to 1.025 for all groups studied, and 5.0 to 8 for pH. The results reported by Herman et al. (2019) showed pH values between 6.6-8.7 in healthy dairy cows. The assessment of faecal score in lactating cows is being presented in Table 7. Faeces colour was olive-brown for all groups studied. Faecal consistency and faecal content scores varied over the different observation time points. On d 0, the faecal consistency was between 2.8-2.9 for all

groups, and the faecal content of 3.1-3.2 scores (undigested feed particles) for the E_1 and the E_2 groups, and 3.3 score for the C group. On d 28, scores were substantially different, dairy cows having consistency scores of 3 (E_1), 3.4 (E_2), 3.7 (C), and faecal content scores of 3 for the E_1 and the E_2 groups, and respectively 3.5 faecal content score (large fragments of undigested feed) for the C group.

Table 7. The assessment of faeces in the lactating cows studied

Scale/groups	Treatment					
	d 0			d 28		
	E_1	E_2	C	E_1	E_2	C
Colour	Olive brown	Olive brown	Olive brown	Olive brown	Olive brown	Olive brown
Consistency	2.8 (3.64 cm)	2.9 (3.50 cm)	2.8 (3.65 cm)	3 (3.55 cm)	3.4(3.80 cm)	3.7 (4.00 cm)
Content	3.2	3.1	3.30	3	3	3.50

C=diet supplemented with 0 g inactive dry yeast/had/day; E_1=diet supplemented with 120 g inactive dry yeast/had/day; E_2=diet supplemented with 150 g inactive dry yeast/had/day.

CONCLUSIONS

Supplementing dairy cows diets with inactive dry yeast increased the milk yield and lactose percentage, without affecting fat and protein content and with a strong tendency for treatment effects on haematological (HTC, WBC, MO, ALP) and biochemical (ALP) parameteres being observed.

The urine parameters studied were not influenced by the inactive dry yeast addition in the dairy cows diets, however, for faecal score, an optimization of the digestion efficiency during the study has been detected.

Factors related to feeding behavior, such as feed and water intake rates, and physiological factors are variable from one animal to another, and might explain the differences in the obtained results of the two experimental groups with the control group.

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