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EFFECT OF DIETARY SUPPLEMENTATION WITH AUTOLYZED *SACCHAROMYCES CEREVISIAE* YEAST AND MULTI-STRAIN PROBIOTIC FORMULATION ON ON GROWTH PERFORMANCE AND *LONGISSIMUS DORSI* MUSCLE CHARACTERISTICS IN WHITE-HEADED MUTTON RAMS

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A b s t r a c t

The objective of this study was to determine the effect of dietary supplementation with autolyzed *Saccharomyces cerevisiae* and a probiotic product on the growth performance and meatiness of sheep. White-headed mutton rams aged 16 months ± 14 days (n = 18) with similar initial body weight (40.8 kg ± 1 %) were divided into three groups of six animals each: control (C) and two experimental groups (E_1, E_2). Throughout the 30-day experience period animals received a product containing *Saccharomyces cerevisiae* yeast in group II, and preparation consisting of a mixture of bacteria (*Lactobacillus plantarum, Lactobacillus rhamnosus, Bifidobacterium animalis*) in group III. The following parameters have been determined in rams: body weight, average daily gain, growth rate, the dimensions of *musculus longissimus dorsi* sections, fat thickness over the loin-eye area. It was found that the rams administered supplements had a higher body weight, average daily gain compared to the control group, but the noted differences were not significant. The animals in experimental group also had a more favorable musculature development. Dietary supplementation with autolyzed Saccharomyces cerevisiae yeast, used alone or in combination with probiotics, had no significant effect on the growth or characteristics of the *longissimus dorsi* muscle in rams.

Introduction

Autolyzed yeast cultures are effective feed additives for ruminants. *Saccharomyces cerevisiae* is one of the most popular yeast species. It is widely used as a substrate, primarily in the form of a lyophilizate, in the

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feed industry (SHURSON 2018). Other yeast species, sourced from the dairy industry (*Kluyveromyces fragilis,* referred to as the "whey yeast") and the pulp and paper industry (*Candida utilis*, known as Torula), are also used in animal nutrition. Supplemental yeast included in livestock diets contributes to reducing feed protein costs and enhancing animal health, thus improving performance and increasing profitability in livestock production (PANG et al. 2022).

Selected yeast strains used as feed additives not only enhance the nutritional value of animal diets but also confer probiotic effects (MARKOWIAK and ŚLIŻEWSKA 2018). In young ruminants, dietary supplementation with yeast species such as *S. cerevisiae* can lead to accelerated proventriculus development, reduced incidence of enteritis, improved feed conversion, increased daily gain, and enhanced resistance to stress induced by transportation and environmental factors (ELGHANDOUR et al. 2024). Commercial yeast-derived feed additives can be divided into categories such as yeast extracts, yeast β-glucans, autolyzed yeast, and hydrolyzed yeast (TAKALLOO et al. 2020). Autolyzed yeast is a relatively novel feed material. Autolysis is a degradation process that involves the activation of intracellular enzymes responsible for solubilizing cell components withing the cell (PERRICONE et al. 2022). Autolyzed yeast is composed of the total content of yeast residues remaining after lysis. Therefore, it contains B vitamins, peptides, amino acids, and nucleotides (ADILI et al. 2020). Moreover, the autolysis of live yeast leads to the release of bioactive compounds such as polysaccharides, including mannan-oligosaccharides (MOS) and β-glucan that form yeast cell walls (BAEK et al. 2024). The composition of autolyzed yeast varies depending on the production process. Autolyzed *S. cerevisiae* yeast usually contains 55–64 % β-glucans, 35–40 % MOS, 13 % protein, 9 % lipids, and 2 % chitin (NAMTED et al. 2021). Mannan-oligosaccharides and β-glucans play an important role in the immune response (NASIRI et al. 2023). The immunoregulatory activity of β-glucans is primarily linked to its ability to stimulate or inhibit the release of cytokines by macrophages, which are involved in immune system control, or to modulate macrophage phagocytosis (PETRAVIĆ-TOMINAC et al. 2010).

The key mechanisms of action of autolyzed *S. cerevisiae* yeast in ruminants include the stabilization of ruminal microbiota by promoting the proliferation of cellulolytic bacteria, which enhances fermentation and increases the concentrations of short-chain fatty acids. The above leads to rumen pH stability and increased digestibility of neutral detergent fiber and crude protein (GIOTTO et al. 2022, TAKIYA et al. 2024). Due to the presence of other valuable components, such as bioactive metabolites and B vitamins, autolyzed yeast can support resistance mechanisms and counteract oxidative stress in animals. KNOLLINGER et al. (2022) demonstrated that autolyzed yeast

supplementation did not negatively impact nutrient digestibility, which confirms that it can be safely used in intensive cattle production. A positive effect of autolyzed yeast on the immune response of dairy cows exposed to heat stress during the transition period and early lactation was reported by NASIRI et al. (2023) and ADILI et al. (2020), respectively.

The existing literature provides limited information on the dietary use of autolyzed yeast, and even less on its combinations with probiotics. Therefore, the aim of the present study was to determine the effect of dietary supplementation with autolyzed *S. cerevisiae* and a probiotic product composed of *Lactobacillus plantarum, Lactobacillus rhamnosus,* and *Bifidobacterium animalis* strains on the growth performance and characteristics of the *longissimus dorsi* muscle in White-headed Mutton rams.

Materials and Methods

The study was conducted in the city of Olsztyn (Region of Warmia and Mazury, Poland), located at 53°46' North latitude, 20°30' East longitude, and an altitude of 128 m. The animals were housed in a free-stall sheepfold, on polypropylene slatted floors, under standard conditions, in accordance with Directive 98/58/EC and the principles of the European Convention for the Protection of Animals. All procedures related to the animals used in this study were approved by the Local Ethics Committee for Animal Experiments in Olsztyn (Decision No. 35/2025).

The experiment was performed on 18 white-headed mutton sheep. Rams aged 16 months ± 14 days were divided into three groups of six animals each (control – C and experimental – E_1, E_2) with a similar body weight of 40.8 kg ± 1 %. In each group, rams were administered supplements in the form of an aqueous solution (80 ml) *per os* for 30 days. Group E_1 animals received a product containing autolyzed *Saccharomyces cerevisiae* yeast at 0.2 g/kg body weight. In group E_2, in addition to the yeast, a selected preparation consisting of a mixture of bacteria (*Lactobacillus plantarum, Lactobacillus rhamnosus, Bifidobacterium animalis*) was administered at 0.03 g/kg body weight. Control group sheep received an equivalent volume of water as a placebo using the same oral administration procedure (placebo--controlled supplementation), to replicate the procedures associated with supplement administration in the experimental groups.

In control and experimental groups, animals were administered identical diets: meadow hay at 1 kg/animal/day, pre-wilted grass and legumes at 2.5 kg/animal/day, oat straw at 0.5 kg/animal/day, and oat grain at 0.3 kg/animal/day, to achieve equal feeding levels. Uniform feeding

standards were applied in in control and experimental groups, in line with the nutrient requirements of rams (OSIKOWSKI et al. 1998).

The following meat performance traits were analyzed: body weight [kg] at the beginning of the study (day 1) and on days 15 and 30 of the experiment, average daily gain [g], relative growth rate [%] at the following time intervals: days 1–15, 15–30, and 1–30 of the experiment; meatiness and fatness were determined in vivo by ultrasound examination at the beginning of the study and on days 15 and 30 of the experiment. Body weight [kg] was measured individually for each animal at the beginning of the experiment (day 1) and on days 15 and 30 using a calibrated digital mobile scale for sheep (Radwag®, model H315.4I.2000.S2). Average daily gain (ADG, g/day) was calculated for each experimental period (days 1–15, 15–30, and 1–30) as the difference between final and initial body weight divided by the number of days in the respective interval.

The relative growth rate (RGR) of lambs in selected rearing periods was determined using the below formula:

$$\text{RGR} = \frac{\text{final body weight} - \text{initial body weight}}{\frac{1}{2}\,(\text{initial body weight} + \text{final body weight})} \cdot 100\ [\%]$$

Meatiness was evaluated based on the dimensions of the *longissimus dorsi* (LD) muscle, including depth, width, and area, whereas fatness was assessed based on skin and fat thickness, and back fat thickness over the loin "eye" area. The measurements were performed after the last thoracic vertebra, i.e. between the 12^{th} and 13^{th} ribs (GERALDO et al. 2023) using the Mindray DP50 ultrasound system (Shenzhen Mindray Bio-Medical Electronics Co., Ltd.) with a 7.5 MHz linear probe.

Statistical analyses were performed using Statistica ver. 13.3. The normality of data distribution was tested using the Kolmogorov–Smirnov and Lilliefors tests, as well as the Shapiro–Wilk W test. Further analysis was performed by comparing multiple independent samples, and the results were verified at a significance level of $p \leq 0.05$.

Results and Discussion

The body weight, RGR and ADG of rams are presented in Table 1. Animals from experimental groups E_1 and E_2 were characterized by higher final body weight and higher average daily gain than control group rams, but the noted differences were not significant.

Table 1

Body weight, average daily gain, and relative growth rate of rams

Parameter	Group					
	E_1		E_2		C	
	x̄	s	x̄	s	x̄	s
Body weight [kg]						
day 1	40.93	6.54	40.85	6.34	40.43	4.85
day 15	41.90	6.96	41.62	6.61	41.70	5.05
day 30	44.23	6.21	44.37	6.23	43.90	4.54
Average daily gain [g]						
days 1–15	64.44	44.36	51.11	41.02	84.44	45.15
days 15–30	155.56	72.50	183.33	56.37	146.67	107.83
days 1–30	110.00	31.55	117.22	30.65	115.56	47.13
Relative growth rate [%]						
days 1–15	2.25	1.34	1.83	1.37	3.08	1.49
days 15–30	5.76	3.36	6,62	2.42	5.29	4.20
days 1–30	8.01	3.08	8.44	2.43	8.37	3.93

Ultrasound scans revealed that dietary supplementation with autolyzed *S. cerevisiae* yeast, alone and in combination with a probiotic product, had no effect on the dimensions of the LD muscle of rams (Table 2). Back fat thickness over the loin "eye" area was similar in all groups.

Table 2

Ultrasound scanning of the *longissimus dorsi* muscle of rams

Parameter	Days of age	Group					
		E_1		E_2		C	
		x̄	s	x̄	s	x̄	s
Depth [cm]	1	1.91	0.11	1.89	0.17	1.91	0.28
	15	1.94	0.26	1.92	0.15	1.95	0.32
	30	1.99	0.24	2.03	0.23	2.09	0.37
Width [cm]	1	5.04	0.59	5.12	0.31	5.02	0.45
	15	5.41	0.43	5.33	0.30	5.59	0.39
	30	5.42	0.27	5.40	0.50	5.60	0.22
Area [cm^2]	1	6.76	1.10	7.07	1.04	7.20	1.27
	15	7.82	1.27	7.61	0.81	8.01	1.37
	30	8.20	1.21	8.01	1.01	8.59	1.43
Fat thickness over "eye" loin [cm]	1	0.16	0.02	0.26	0.22	0.17	0,01
	15	0.20	0.07	0.23	0.04	0.18	0.05
	30	0.21	0.06	0.23	0.05	0.20	0.02

Many studies have shown that supplemental autolyzed yeast does not increase the body weight of the analyzed animals. This could be due to the too low inclusion levels of the supplement in their diets, which likely reduced its prebiotic effects in the rumen. SCHUH et al. (2025) also found that dietary supplementation with autolyzed *S. cerevisiae* yeast at 5 g/animal/day had

no significant effect on the body weight and average daily gain of lambs. A lack of effect of yeast supplementation also reported by KNOLLINGER et al. (2022). In this the work autolyzed yeast added to diets for Holstein cows at 15 g, 30 g, and 45 g per day had no influence on the body weight of animals. In a study by PONTAROLO et al. (2021), experimental beef steers that received autolyzed yeast in the diet at 4 g and 7 g/animal/day were characterized by greater daily body weight gain and better feed conversion in the initial feedlot phase, compared with control group animals, but this effect was not observed in the following phases.

BARDUCCI et al. (2024) examined monogastric animals, namely weaned piglets fed autolyzed yeast and β-glucans as a blood plasma alternative in diets and found that daily weight gain was not affected by the supplement, whereas survival rates and feed efficiency were higher in experimental groups. Similar observations were made by NAMTED et al. (2021). In their study, the body weight gain of piglets in control and experimental groups was not differentiated by 1.0 % autolyzed yeast supplementation. In turn, autolyzed *S. cerevisiae* yeast improved the growth performance of poultry, including body weight gain and the feed conversion ratio (PERRICONE et al. 2022). A beneficial influence of supplemental yeast was observed in broilers (MUTHUSAMY et al. 2011) and Japanese quail (KORDPOUR and SALARI 2023). MUTHUSAMY et al. (2011) demonstrated that hydrolyzed yeast supplementation improved the body weight of broilers at 21 and 42 days of age, compared with the control group. In turn, live weight gain was not altered by the diet until day 21, but it increased on days 22–42 in supplemented birds.

Conclusions

It can be concluded that dietary supplementation with autolyzed *S. cerevisiae* yeast culture, alone and in combination with a probiotic product, had no effect on the dimensions and fat content of the LD muscle or on performance parameters such as the body weight, average daily gain, and growth rate of rams housed in a conventional system.

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