Effect of yeast supplementation and weight at slaughter on growth performance, carcass traits and body composition in Awassi male lambs

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Abstract

To study the effects of supplementing *Saccharomyces cerevisiae* (yeast) and weight at slaughter on growth performance and carcass characteristics, sixteen weaned Awassi male lambs were used (4–4.5 months) and averaged 29.2 kg in weight. The lambs were divided equally into two groups. The first group was considered as a control (C), while the diet in the second group (T) was supplemented with 5 g of yeast/lamb/day, and all lambs were slaughtered from each group at 40 and 45 kg. Results revealed that lambs fed 5 g of yeast/lamb/day in T groups reached their target slaughter weight faster than lambs in C groups (61.13 vs. 72.75 days). The daily gain in weight was numerically higher, and the feed conversion ratio was better in the T groups compared to the control. Moreover, dressing percentages based on live and empty body weight, shrinkage, rib-eye area and fat thickness were not significantly affected by supplementing yeast. It was noticed that lambs slaughtered at 45 kg had a substantially ($P<0.05$) larger rib-eye area and a higher percentage of subcutaneous fat and dressing based on live and empty body weight than lambs slaughtered at 40 kg. Lean and fat content were numerically higher in the rack cuts in lambs fed yeast than in the control. However, lean content decreased and fat increased with increasing slaughter weight from 40 to 45 kg. In addition, neither yeast supplementation nor slaughter weight had a significant effect on non-carcass fats.

Keywords Daily gain, Dressing percentage, Tissue distribution

Introduction

In Iraq, sheep are regarded as the most valuable animal, and the sale of lambs and mutton generates the majority of income [1]. Furthermore, their importance is further enhanced by the fact that they are the most suitable farm animals for most of the nation's arid and semi-arid areas, serving as the primary source of income for the local rural population [2]. Animal growth and development are known to be impacted by feed additives, and it has been demonstrated that the application of live yeasts as feed additives has been widely researched [3, 4]. In addition, Saccharomyces cerevisiae is typically used in animal diets to enhance the nutritional digestibility [5, 6, 7], feed intake [8], average daily gain (ADG) [9], and carcass characteristics [10]. Growth performance and carcass traits are also affected by slaughter weight. For carcass and meat quality, particularly fat content, producers have to know the optimum slaughter weight. Raising the slaughter body weight above 35 kg may increase the dressing percentage without affecting [11, 12]. Therefore, this study aimed to evaluate the effect of adding Saccharomyces cerevisiae as feed additives and different slaughter weights on growth performance and carcass traits of Awassi lambs.

Materials and Methods

Animals and Experimental Design

Sixteen weaned Awassi male lambs (4-5 months) were used in this study, with an average initial weight of 29.2±0.75 kg, and raised at the Grdarasha field, College of Agricultural Engineering Sciences, Salahaddin University. After an adaptation period of 14 days, lambs were weighed and randomly divided equally into two groups (8 lambs each). The first group received 3.5% of their body weight concentrate and roughage (7030), respectively. While the second group received the first group's diet with 5 g of yeast/lamb/day. All lambs were slaughtered from each group at 40 and 45 kg (four lambs each). Each group of lambs was housed in a different pen and fed as a group. The yeast chemically consists of 43.2 g protein/100 g, 321 kcal energy/100 g, 1.8 g fat/100 g, and 34.2 g carbohydrate/100 g. The composition of the experimental concentrate diet included 38% barley, 35% wheat bran, 10% soybean meal, 15% corn, 1% sodium bicarbonate, and 1% salt. Following the quantification and removal of the previous day's residue, the concentrate (15.4% crude protein and 2672.6 kcal/kg metabolizable energy) and straw (2.5% crude protein) were fed at 830 am and 830 pm. Mineral blocks, multivitamins, and clean water were constantly available. Before feed was given in the morning, each lamb was weighed once a week.

Slaughtering of the Animals

All lambs were slaughtered at 40 and 45 kg using the Islamic technique at the slaughterhouse [13] by severing the throat and the main blood veins in the neck after fasting for 12 hours with unrestricted access to water. Evisceration was carried out immediately after skinning was finished, and the hot carcass was weighed and recorded.

Carcass Traits

An electrical saw was used to cut the carcass in half along the spinal column after it had been cooled for 24 hours at 4°C. The pelvic fat and the kidney have been taken out and weighed separately. The left half of the carcass was divided into nine cuts and weighed. A Placom digital planimeter was used to measure the rib-eye area at the 12th rib. A digital caliper device was used to measure the thickness of fat above the midpoint of the *L-dorsi* muscle perpendicularly.

Physical Dissection

The racks of the left half carcasses of all lambs were weighed and dissected completely into lean, fat, and bone. The three components were weighed separately to determine their percentages. Also, the weight of non-carcass fat components was recorded separately, and it includes the omental, mesenteric, pelvic, kidney, scrotal, and cardiac fat.

Statistical Analysis

SAS [14] applied the general linear model (GLM) for statistical analysis to evaluate the impact of slaughter weight and yeast supplementation on the studied traits. Subclasses of each factor were tested for differences using Duncan's multiple range tests [15].

Results and Discussion

Growth Performance

The effect of supplementing *Saccharomyces Cervisiae* and slaughter weight on the performance of lambs is shown in Table (1). The average daily gain of lambs fed 5 gm yeast/lamb/day was higher than the control group (0.205 ± 0.01 vs. 0.175 ± 0.01 kg), and there was no significant difference between them (P>0.05). Likewise, Afrouzi et al. [16] noticed that the daily gain in weight in the treated groups 4, 6, and 8 g yeast/lamb/day was numerically higher than that of the control. Also, Xu et al. [17] showed that adding 3, 6, 9, and 12% of yeast to the diet had a higher daily gain than the control. Moreover, Osita et al. [18] found that lambs offered 0.75 and 1.5 g of yeast/kg diets had significantly greater daily gains (P<0.05) than the control. The higher growth rate results from a greater flow of microbial protein out of the rumen and a larger supply of different amino acids entering the small intestine [19, 20, 21, 22].

During the current research, it was observed that a slight difference occurred in average daily gain among lambs slaughtered at 40 and 45 kg (P>0.05) (0.190 ± 0.01 vs. 0.189 ± 0.01 kg/day). Such a decline in gain is mainly due to fat deposition [23]. Similarly, it has been indicated that with increasing slaughter weight, daily live weight gain decreases [24, 25]. Moreover, Oramari et al. [26] showed that lambs slaughtered at 30 kg had greater daily gain than lambs slaughtered at 40 kg. However, Yateem et al. [27] showed that average daily weight gain rose as slaughter weight increased from 20 and 25 to 30 kg. Moreover, it seems from the result that lambs in the T group reached their target weights and were shorter than the control (61.13 vs. 72.75 days).

Feed Conversion Ratio

In the current work, the feed conversion ratio averaged 6.149 kg/kg (Table 1), and it seems that the feed conversion ratio in the treated group was better than in the control (5.691 vs. 6.611 kg/kg). Likewise, Osita et al. [18] and Gloria-Trujillo et al. [28] noticed that by adding yeast to the lamb's diet, the feed conversion ratio was improved compared to the control. Also, Afrouzi et al. [16] showed that lambs fed 4, 6, and 8 g of yeast/day had a better feed conversion ratio than the control. It was shown that

Saccharomyces cerevisiae supplementation resulted in a higher feed digestibility and greater efficiency of nutrient utilization [29, 30, 31]. In the current work, the feed conversion ratio decreased from 6.196 to 6.115 kg/kg with an increase in slaughter weight from 40 to 45 kg, respectively, possibly due to increased fat deposition. It's interesting to note that since lambs are fed in groups, no statistical analysis was done for this trait. Likewise, AL-Sherwany and Alkass [13] and Yateem et al. [27] revealed that with increasing slaughter weight, the feed conversion ratio decreased.

Table (1) Effect of supplementing *Saccharomyces Cerevisiae* and slaughter weights on the growth performance of Awassi male lambs.

Effects	Overall mean	Diet		Slaughter Wt.	
		Without yeast (Control)	With 5 g of yeast/lamb/day	40 kg	45 kg
No.	16	8	8	8	8
Initial wt. (kg)	29.92 ± 0.75	29.91 ± 0.69 a	29.93 ± 1.38 a	29.55 ± 0.75 a	30.29 ± 1.33 a
Final wt. (kg)	42.44 ± 0.65	42.38 ± 0.94 a	42.50 ± 0.95 a	39.96 ± 0.12 b	44.93 ± 0.14 a
Period (day)	66.44 ± 4.51	72.75 ± 6.34 a	61.13 ± 6.23 a	56.00 ± 5.36 b	76.88 ± 5.23 a
ADG (kg)	0.19 ± 0.01	0.175 ± 0.01 a	0.205 ± 0.01 a	0.190 ± 0.01 a	0.189 ± 0.01 a
FCR (kg/kg)	6.149	6.611	5.691	6.196	6.115

Means with different letters differ significantly within each row (P<0.05).
ADG = Average Daily Gain. FCR = Feed Convention Ratio.

Carcass Traits

Based on live and empty body weight, the overall means of dressing percentage were 47.93 ± 0.45 and 54.86 ± 0.45%, respectively (Table 2). It was noticed that dressing percentage in the treated group was numerically lower compared with the control, based on live and empty body weight. Similarly, Song et al. [32] noticed that lambs fed yeast had a lower dressing percentage compared to the control. Also, Froes et al. [33] found that the dressing percentage declined in the treatment group compared to the control. Moreover, Hamdon and Farghaly [20] demonstrated that the dressing percentage in the additive group was significantly lower (P<0.05) than in the control. The reason for the lower dressing percentage of treated lambs with yeast would mostly be a result of increased non-carcass weight, especially the digestive tract [34]. It can be observed from Table 2 that as slaughter weight increased from 40 to 45 kg, dressing percentage increased from 47.14 to 48.71% as a percentage of live body weight and from 54.37 to 55.34% as a percentage of empty body weight, and the differences were not significant. Similarly, some workers noticed that the dressing percentage was increased with increased slaughter weight [13, 27, 35]. One possible explanation for this rise in dressing percentage is the variation in the level of maturity of the carcass and non-carcass components [27]. Also, the reason for the difference in dressing percentage will possibly be attributed to the lower gut content for lambs slaughtered at 45 kg (12.16%) compared to those slaughtered at 40 kg (12.89%).

It was noticed that supplementing 5 g of yeast/lamb/day had no significant effect on shrinkage percentage when compared with the control (P>0.05) (Table 2). Moreover, lambs slaughtered at 40 kg had lower shrinkage percentages than lambs slaughtered at 45 kg (2.59 vs. 2.65%), and there was no significant difference (P<0.05) (Table 2). Similarly, Yateem et al. [27] discovered that when the slaughter weight was raised from 20 to 30 kg, the shrinkage percentage rose. In the present work, the control group had a larger rib-eye area compared to the treatment (15.31 vs. 15.09 cm^2) (Table 2). These results are similar to those previously documented on the impact of yeast supplementation [32, 33, 36], which revealed that lambs fed with yeast had lower rib-eye area compared with controls. As slaughter weight increased from 40 to 45 kg, the rib-eye area expanded considerably (P<0.05) (13.70 ± 0.54 vs. 16.70 ± 0.57 cm^2) (Table 2). Similarly, several authors reported that an increase in rib-eye area occurred with an increase in slaughter weight [24, 27, 37, 38].

In the present work, lambs fed yeast had thicker fat over the *Longissimus dorsi muscle* than lambs fed the control diet (2.93 vs. 2.91 mm), and the differences were not significant (P>0.05) (Table 2). Likewise, Song et al. [32], Froes et al. [33], and Titi et al. [34] reported that fat thickness was increased in lambs fed with yeast supplementation compared with controls. Also, fat thickness increased from 2.78 to 3.06 mm with an increase in slaughter weight (40 to 45 kg). Similarly, some authors indicated that the fat was found to be thicker when slaughter weight increased [24, 38]. Deposition of fat, a late-maturing tissue, is the cause of this rise in fat thickness [27].

Wholesale Cuts

Based on Table (3), it seems that there were no significant differences in all carcass cuts in treated groups except loin, which was higher, and breast and flank, which were significantly lower compared to the control. Similarly, Aldoori and Al-Obaidi [36] reported that lambs fed a yeast supplement did not have a significant effect on all carcass cuts. While, Hamdon and Farghaly [20] noticed an increase in flank weight in the treated group compared to the control. On the effect of slaughter weight, it reveals that the shoulder cut had a significantly (P<0.05) lower value in lambs slaughtered at 40 kg compared to lambs slaughtered at 45 kg (17.82 vs. 18.45). Additionally, Table (3) shows that the effect of fat deposition was reflected in the rise in fat tail as a percentage of chilled carcass weight with increasing slaughter weight. Palsson and Verges [39] reported that these changes reflect the variation in maturity rate between the wholesale cuts.

Table (2) Effect of supplementing *Saccharomyces Cerevisiae* and slaughter weights on some carcass traits of Awassi lambs.

Effects	Overall mean	Diet		Slaughter Wt.	
		Without yeast (Control)	With 5 g of yeast/lamb/day	40 kg	45 kg
No.	16	8	8	8	8
Slaughter wt. (kg)	42.44±0.65	42.38 ± 0.94 a	42.50 ± 0.95 a	39.94± 0.12 b	44.93 ± 0.14 a
Hot carcass wt. (kg)	20.36±0.43	20.34 ± 0.59 a	20.38 ± 0.66 a	18.84 ± 0.26 b	21.86 ± 0.22 a
Chilled carcass wt. (kg)	19.83±0.42	19.81 ± 0.57 a	19.85 ± 0.65 a	18.35 ± 0.25 b	21.32 ± 0.23 a
Shrinkage %	2.62±0.05	2.63 ± 0.08 a	2.60 ± 0.05 a	2.59 ± 0.07 a	2.65 ± 0.07 a
Dressing%/ live body weight	47.93±0.45	47.94 ± 0.47 a	47.92 ± 0.81 a	47.14 ± 0.52 a	48.71 ± 0.57 a
Dressing%/ empty body weight	54.86±0.45	54.87 ± 0.44 a	54.85 ± 0.81 a	54.37 ± 0.65 a	55.34 ± 0.6 a
Rib-eye area (cm^2)	15.20±0.61	15.31 ± 0.89 a	15.09 ± 0.91 a	13.70 ± 0.54 b	16.70 ± 0.57 a
Fat thickness (mm)	2.92±0.19	2.91 ± 0.22 a	2.93 ± 0.32 a	2.78 ± 0.26 a	3.06 ± 0.28 a

Means with different letters differ significantly within each row (P<0.05).

Table (3) Effect of supplementing *Saccharomyces Cerevisiae* and slaughter weights on carcass cuts of Awassi lambs

Effects		Overall mean	Diet		Slaughter Wt.	
			Without yeast (Control)	With 5 g of yeast/lamb/day	40 kg	45 kg
No.		16	8	8	8	8
Left side carcass		9.74 ± 0.24	9.66 ± 0.28 a	9.81 ± 0.22 a	9.07 ± 0.18 b	10.41 ± 0.28 a
As a % of chilled carcass wt.	Legs	29.19 ± 0.46	28.68 ± 0.73 a	29.69 ± 0.56 a	30.01 ± 0.33 a	28.36 ± 0.78 a
	Loin	9.17 ± 0.07	9.00 ± 0.06 b	9.33 ± 0.09 a	9.19 ± 0.11 a	9.14 ± 0.09 a
	Neck	7.52 ± 0.2	7.64 ± 0.35 a	7.40 ± 0.22 a	7.35 ± 0.18 a	7.69 ± 0.37 a
	Shoul-der	18.14 ± 0.16	18.26 ± 0.25 a	18.01 ± 0.19 a	17.82 ± 0.17 b	18.45 ± 0.2 a

	Fore shank	2.98 ± 0.07	2.96 ± 0.08 a	3.01 ± 0.1 a	2.94 ± 0.12 a	3.03 ± 0.05 a
	Breast	11.69 ± 0.22	12.31 ± 0.18 a	11.07 ± 0.27 b	11.98 ± 0.32 a	11.40 ± 0.3 a
	Rack	6.81 ± 0.17	6.05 ± 0.23 a	5.56 ± 0.22 a	5.56 ± 0.26 a	6.05 ± 0.19 a
	Flank	2.98 ± 0.11	3.23 ± 0.14 a	2.73 ± 0.13 b	2.94 ± 0.15 a	3.01 ± 0.17 a
	Fat tail	12.53 ± 0.48	11.87 ± 0.63 a	13.20 ± 0.68 a	12.21 ± 0.62 a	12.86 ± 0.75 a

Means with different letters differ significantly within each row ($P<0.05$).

Tissue distribution of the rack

The proportion of tissue in rack cuts of lambs in the control and T groups and slaughtered at 40 and 45 kg are given in Figures (1 and 2). It seems from figure (1) that the lean and fat percentage for lambs fed yeast in the treatment group had numerically surpassed the control group, which had (50.19 vs. 49.78) and (24.22 vs. 22.16), respectively. However, the bone percentage for lambs in the control group was higher compared with the treatment group. Similarly, Gadekar et al. [40] noticed that the lambs fed yeast had numerically higher percentages of fat and lower percentages of bone in rack cuts compared with the control group.

As slaughter weight increases from 40 to 45 kg, the percentage of lean and bone decreases (Figure 2). Such results could be attributed to the fact that bone is an early maturity carcass component, so it grows at a slower rate during post-natal life and consequently decreases with increasing body weight [41, 42]. However, an increase in the percentage of fat was noticed in the rack cuts with increased slaughter weight from 40 to 45 kg, which had (21.49 and 24.89), respectively. It is well known that fat is a late-growing body tissue, and therefore, proportions in the carcass greatly change with the progress of growth [43]. Similarly, several investigations have reported that as slaughter weight increases, there is mainly an increase in fat percentage and a decrease in lean and bone percentages [27, 37, 44, 45].

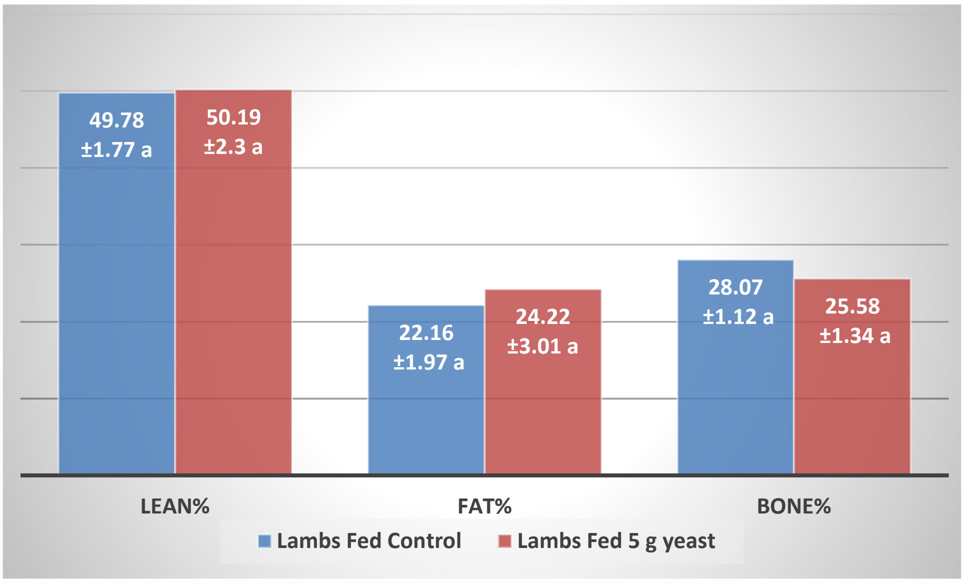

Figure (1) Effect of Supplementing *Saccharomyces Cerevisiae* on lean, fat and bone percentages in the rack cuts of Awassi lambs

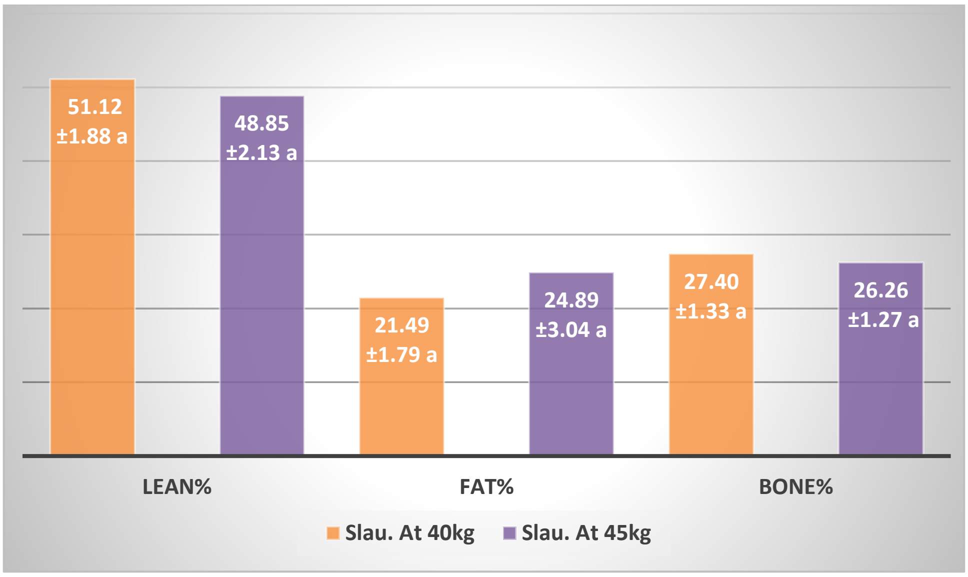

Figure (2) Effect of slaughter weights on lean, fat, and bone percentages in the rack cuts of Awassi lambs

Non-carcass fat

The effect of yeast supplementation and slaughter weight on non-carcass fat is presented in Table (4). The percentage of non-carcass fat of lambs fed yeast supplementation was higher than lambs in the control, which had 3.01 and 2.86, respectively. Also, all components of non-carcass fat (except scrotal fat) are higher in lambs fed yeast supplementation than in lambs in the control group, and the differences were not significant.

Results of this investigation revealed that as slaughter weight increased from 40 to 45 kg, the percentage of non-carcass fat increased numerically from 2.89 to 2.97 (Table 4). It seems that the proportion of omental and scrotal fat in lambs slaughtered at 40 kg

Table (4) Effect of supplementing *Saccharomyces Cerevisiae* and slaughter weights on non-carcass fat of Awassi lambs.

Effects	Overall mean	Diet		Slaughter Wt.	
		Without yeast (Control)	With 5 g of yeast/lamb/day	40kg	45kg
No.	16	8	8	8	8
Non-Carcass fat% As a % of Slaughter wt.	2.93 ± 0.14	2.86 ± 0.28 a	3.01 ± 0.08 a	2.89 ± 0.24 a	2.97 ± 0.18 a
Omental Fat%	1.14 ± 0.08	1.1 ± 0.14 a	1.19 ± 0.08 a	1.16 ± 0.11 a	1.13 ± 0.12 a
Mesenteric Fat %	0.78 ± 0.03	0.75 ± 0.06 a	0.82 ± 0.02 a	0.76 ± 0.06 a	0.81 ± 0.03 a
Kidney and pelvic Fat%	0.66 ± 0.04	0.65 ± 0.08 a	0.66 ± 0.02 a	0.64 ± 0.07 a	0.67 ± 0.05 a
Heart Fat%	0.12 ± 0.01	0.12 ± 0.02 a	0.13 ± 0.01 a	0.11 ± 0.01 a	0.14 ± 0.02 a
Scrotal Fat%	0.22 ± 0.01	0.24 ± 0.02 a	0.21 ± 0.02 a	0.23 ± 0.02 a	0.22 ± 0.02 a

Means with different letters within each row differ significantly ($P<0.05$) according to Duncan's test.

It was higher than in lambs slaughtered at 45 kg, which had (1.16 vs 1.13) and (0.23 vs 0.22), respectively. Whereas, the percentages of mesenteric, kidney and pelvic, and heart fat were increased with increased slaughter weight. Fat is a late-maturing tissue, and as the animal grew up, the deposition of fat increased. Similarly, several authors reported that the percentage of non-carcass fat increased with increasing slaughter weight [24, 26, 46].

From the results presented above, it can be concluded that lambs fed 5 g of yeast/lamb/day grew faster, with a better feed conversion ratio and a higher average daily gain than lambs in the control. It seems that, as slaughter weight increased, the fat thickness increased numerically and the rib-eye area expanded significantly. Moreover, the percentage of loin cut is higher in lambs fed 5 g of yeast/lamb/day compared to the control. Furthermore, lambs fed 5 g of yeast/lamb/day and lambs slaughtered at 45 kg had higher fat content in the rack cuts compared to lambs in the control and lambs slaughtered at 40 kg.

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