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Effect of Yeast Cell Wall Additive on Digestion, Rumen Fermentation, Some Blood Biochemical and Growth Performance of Baladi Goat Kids

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Abstract

THE two primary polysaccharides found in yeast cell wall (YCW), which is frequently added to animals' diets as a nutritional supplement, are mannan-oligosaccharide and β-glucan. The effect of yeast cell wall (YCW) additive on goat kid's growth performance was investigated using twenty-four growing Baladi male goats, weighing 8.33 ± 0.05 kg and an average age of three months. The kids were assigned to four similar groups according to weight and age, each with six kids, and fed a total mixed diet that included 60% concentrate feed mixture, 25% corn silage, and 15% alfalfa hay. For G1, G2, G3, and G4, the experimental groups were given the entire mixed diet with YCW at 0, 5, 7.5, and 10 g/head/day, respectively. Compared to the control group, the addition of YCW resulted in a notable improvement in all nutrient digestion, nutritional values, rumen fermentation, blood serum biochemicals, feed intake, growth performance, feed conversion ratio, and economic efficiency. Group 3, which was given 7.5 grams/head/day, achieved the highest results of digesting all nutrients, nutritional values, concentrations of total volatile fatty acids, acetate, and propionate in the rumen, total protein, albumin, globulin, and glucose in blood serum, final live body weight, total body weight gain, average daily gain, feed conversion ratio, and economic efficiency. Also, dry matter (DM), total digestible nutrients (TDN), crude protein (CP), digestible crude protein (DCP), and total and net revenues were all higher in G3 ($P<0.05$). But the rumen's pH, ammonia-N, and butyrate concentrations were significantly lower in G3, and the blood serum's triglycerides, cholesterol, urea nitrogen, creatinine, alanine aminotransaminase (ALT), and aspartate transaminase (AST) concentrations were significantly lower in G3 ($P<0.05$). In conclusion, adding 7.5 g/kid/day of YCW in diets of growing kids revealed the beast results, which had a significant positive impact on blood serum biochemicals, digestion, rumen fermentation activity, feed intake, growth performance, feed conversion, and economic efficiency.

Keywords: *Yeast Cell Wall, Growing Kids, Productive Performance, Economic Efficiency.*

Introduction

About 25% of the yeast cell's dry mass is made up of a stiff cell wall, which is between 100 and 200 nm thick. Chitin, two forms of β-glucans, and highly glycosylated glycoproteins (mannoproteins) are the macromolecules that make up the wall [1]. According to calculations based on electron micrographs, the cell wall in S. cerevisiae accounts for 25 to 50% of the volume and 15 to 30% of the dry weight of the cell [2]. Mannoprotein and fibrous β1,3 glucan makes up the majority of the walls [3]. Glucan (35–45%), mannan oligosaccharides (40–45%), protein (5~10%), chitin (1~2%), lipid (3~8%), and inorganic salt (1~3%) make up the majority of the yeast cell walls. Piglets' immunity can be enhanced and lymphocytes, including neutrophils, can proliferate when fed S. cerevisiae cell wall [4]. The animal feed business uses yeast cell walls, also known as mannan-oligosaccharide (MOS), extensively. Mannan oligosaccharides (MOS) and β-glucan are two functional polysaccharides with health-improving qualities that are abundant in yeast cell walls, which are natural feed additives [5].

Yeast β-glucans are known to modulate the immune system, enhancing innate and adaptive immune responses [6, 7]. During the feedlot receiving phase, adding 5 g of mannan and glucan blend as a supplement improves the immunocompetence and productivity of beef cattle [8]. The ability to enhance animal performance [9],

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avoid lactate buildup in the rumen [10], maintain rumen pH [11,12], and reduce the synthesis and absorption of harmful compounds [11,13] are some of the primary advantages of yeast and MOS that have been discussed in the literature. Therefore, these additions may improve nutritional digestibility and cattle performance [14, 15, 16]. As a supplement for calf growth, MOS-β glucan can be replaced with antibiotics [17].

The two primary polysaccharides found in yeast cell walls (YCW), which are frequently utilized as a nutritional supplement in animal diets, are mannan-oligosaccharide and β-glucan. These YCW polysaccharides can absorb pathogens and increase cytokine production, which boosts immunity [18]. The animal feed business yeast cell walls, also known as mannan oligo-saccharides (MOS), to enhance the performance and health of animals. Because yeast cell walls contain 20–30% protein, they have historically been added to animal feed [19].

Yeast cell walls are currently one of the most significant natural feed additives that are frequently utilized as antibiotic substitutes due to their health benefits [20]. The amount of NH3-N in the rumen of goats, cattle, and bulls was considerably reduced by yeast supplementation [10]. The concentration of TVFA in the rumen of sheep and cattle is significantly increased when they are supplemented with yeast in their diet [21]. Heat-stressed goats' rumen fermentation and growth performance can still be significantly enhanced by a low dose of Saccharomyces cerevisiae [22]. Goats' summer growth performance, rumen fermentation, and antioxidant capacity may all be enhanced with a yeast culture supplement. 0.90% DM is the ideal supplementing concentration [23].

Yeast can improve NDF and ADF's digestibility and DMI. As a result, it greatly aids in goat growth and development [24]. Yeast can improve NDF and ADF's digestibility and DMI. As a result, it greatly aids in goat growth and development [24, 25]. The ideal concentration of YCW is 0.4% of the concentrate, and it can be added to feed to support the healthy growth of weaned calves [26]. Saccharomyces cerevisiae produces yeast cell wall (YCW) products. Mannan-oligosaccharides (MOS), β-glucan, and a number of other substances are present in YCW, which is frequently employed as a feed additive [27]. Animals' healthy growth is positively impacted by these substances [28].

Additionally, YCW's polysaccharides have the ability to absorb pathogens and promote the release of anti-inflammatory cytokines, both of which boost immunity [18]. Growth performance [29] and the synthesis of volatile fatty acids (VFA) [30] are both positively impacted by YCW. Furthermore, some research found that adding YCW to ruminants' diets enhances their average daily gain (ADG) and dry matter intake (DMI) [31]. VFA production and growth performance were enhanced by dietary supplementation with YCW [32].

Investigating the effects of adding cell wall yeast to the diets of developing Baladi goat kids on feed intake, digestibility, rumen parameters, blood metabolizes, growth performance, and economic efficiency was the focus of this study.

Material and Methods

In collaboration with the Department of Animal Production, Faculty of Agriculture, Kafrelsheikh University, the current study was conducted at Karada Animal Production Research Station, which is belonging to Animal Production Research Institute, Agricultural Research Center, in 2023.

Yeast cell wall:

Angel Yeast Egypt Company LTD. produces the cell wall locally from a yeast culture (Saccharomyces cerevisiae). According to the registration form L23/3059R, registration number 4563 at 2023, the yeast cell wall contains 18.98% mannan-oligosaccharide, 17.24% β-glucans, 4.5% moisture, 4.84% ash, 15.35% crude protein, 9.56% fat, 56.74% total fiber, 52.56% soluble fiber, and 4.18% insoluble fiber.

Animals and Experimental Diets:

During a 150-day growth trial, twenty-four Baladi male goats that were on average three months old and weighed 8.33 ± 0.05 kg were assigned to four similar groups of six kids each based on their weight and age. To meet their nutritional demands based on their body weight, the animals were fed a total mixed diet that included 60% concentrate feed, 25% corn silage, and 15% alfalfa hay, per NRC [33]. For G1, G2, G3, and G4, the experimental groups were given the basal diet along with doses of yeast cell wall of 0, 5, 7.5, and 10 g, respectively. The concentrate feed mixture consisted of 30% wheat bran, 41.7% yellow maize grain, 15% undecorticated cottonseed meal, 7% linseed meal, 3% molasses, 2% limestone, 1% sodium chloride, and 0.3% mineral and vitamin premix. Table (1) lists the chemical makeup of the feed ingredients used in the experimental diet.

Management procedure:

Kids were fed separately (at 8 a.m.) and kept in an open yard with a shed that took up around one-third of the space. Kids were given a total mixed diet in a group setting every day at 8 a.m., with the quantity of the food being changed every two weeks based on changes in live body weight. All day long, water was accessible without charge. All kids were housed in semi-shaded open yards for each group and kept under the same environmental and hygienic experimental conditions. Kids were weighed overnight before breakfast at the start of the experiment and every two weeks after that to track weight changes for calculating live weight gain and modifying their meal requirements as needed.

Digestibility trails:

Using acid insoluble ash (AIA) as a natural marker, four digestibility trials were conducted for four experimental groups three months after the feeding trial to ascertain the feeding values and nutrient digestion of the investigated diets [34]. Over five days, samples of each animal's feces were collected twice daily at 12-hour intervals from the rectum. Dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE), and nitrogen free extract (NFE) were measured in feed and feces samples using the AOAC's techniques [35]. In accordance with Van Soest et al. [36], feeds were further tested for neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL). The Schneider and Flat formulae were used to determine nutrient digestibility [37].

$$= 100 - \left(100 \times \frac{AIA\%\ in\ feed}{AIA\%\ in\ feces}\right)$$

$$: \left(\frac{Nutrient\%\ in\ feces}{Nutrient\%\ in\ feed}\right)$$

The usual formula of McDonald et al. [38] was used to compute digestible crude protein (DCP) and total digestible nutrients (TDN).

TDN = (CP × CPD + CF × CFD + EE × EED × 2.25 + NFE × NFED)/100

DCP = (CP × CPD)/100

CPD: Crude protein digestibility, CFD: crude fiber digestibility, EED: ether extract digestibility, NFED: nitrogen free extract digestibility.

Rumen Liquor Collection and Evaluation:

Using a rubber ruminal probe, samples of rumen liquor were taken from three lambs per group during the digestibility trails three hours after feeding. After straining the rumen liquor through two layers of cheesecloth, the pH was promptly determined with an Orian digital pH meter. Ammonia nitrogen (NH_3-N) was measured using the AOAC technique [35]. The Warner method [39] was used to estimate the total volatile fatty acids (TVFAs), and Filípek and Dvorák [40] were used to determine the VFA fractions in rumen liquor.

Blood samples mmetabolites:

Three hours after the morning meal, each lamb's jugular vein was used to draw blood samples for the digestibility trails. The samples were placed in vacuum tubes devoid of anticoagulants and allowed to clot at room temperature. To extract the serum, the blood samples were centrifuged for 10 minutes at 1500 rpm. The blood serum content of albumin was determined using the Doumas et al. method [42] and total protein using the Weichselbaum method [41]. By deducting the albumin value from the total protein content, the globulin concentrations were calculated. quantitative assessment of blood triglycerides using Buccolo and David's approach [43]. The technique described by Khan et al. [44] was used to measure the cholesterol concentration. In order to quantify glucose, the Tinder method was used [45]. The Marsh et al. method [46] was used to measure the urea nitrogen concentration. The methods of Bartels and Böhmer [47] were used to test creatinine. The Reitman and Frankel method was used to quantify the levels of aspartate transaminase (AST) and alanine amino transaminase (ALT) [48].

Dietary conversion ratio:

Kg of dry matter (DM), total digestible nutrients (TDN), crude protein (CP), and digestible crude protein (DCP) per kg of live body weight (LBW) was used to compute the dietary conversion ratio. ADG (average daily gain), DCPI (digestible crude protein intake), CPI (crude protein intake), TDNI (total digestible nutrients intake), and DMI (dry matter intake).

DM (kg/kg gain) = DMI/ADG

TDN (kg/kg gain) = TDNI/ADG

CP (g/kg gain) = CPI/ADG

DCP (g/kg gain) = DCPI/ADG

Economic efficiency:

Economic efficiency was evaluated using the cost of daily feed consumption, daily weight increase income, net revenue, and net revenue improvement. In 2023, CFM cost 14,000 LE per ton, CS cost 1500 LE per ton, AH cost 6000 LE per ton, yeast cell wall cost 400 LE per kg, and live body weight growth cost 240 LE per kg.

Statistical analysis:

IBM SPSS Statistics was used to statistically analyze the collected data [49]. Users were guided through a one-way ANOVA using a modified General Linear Model. To find significant differences in the mean values of dietary treatments at the significance level of $p < 0.05$, Duncan's tests [50] inside the SPSS software were employed. The following model was used to statistically analyze the data:

$$Y_{ij} = \mu + T_i + E_{ij}$$

Where:

Y_{ij} = Observed value of a given dependent variable.

μ = Overall adjusted mean.

T_i = The effect of treatments.

E_{ij} = The experimental random error.

Results

Nutrients digestibility and feeding values:

There was a significant (P<0.05) difference with both G2 and G1 and an insignificant difference with G4 in the digestibility of DM, OM, CP, CF, EE, and NFE as well as TDN and DCP values in the group fed ration supplemented with 7.5 g/h/d yeast cell wall (G3), according to the nutritional values and nutrient digestion data shown in Table (2). Additionally, when compared to G1, G2 and G4 showed a substantial improvement (P<0.05) in feeding parameters and nutritional digestibility. This could be because 7.5 g of YCW is a more effective dose to improve feeding parameters and nutrient digestibility, while lower and higher amounts of YCW are less effective.

Ruminal fermentation parameters:

Ruminal fermentation data in Table (3) showed that the average ruminal pH values for G3 were significantly lower (P<0.05) than those for G1 and G2 when YCW was added at a level of 7.5 g/h/d. However, G1 and G2, G2 and G4 and G3, and G4 did not differ significantly. When comparing growing kids receiving YCW supplemented meals to the control group, the levels of rumen ammonia-N and butyrate were reduced (P<0.05), but the concentrations of total VFAs, acetate, and propionate were greater (P<0.05). While G1 showed the opposite trend, G3 recorded considerably (P<0.05) lower rumen ammonia-N and butyrate and greater total VFAs, acetate, and propionate concentrations. G4 and G2 followed suit.

Blood serum biochemicals:

Table (3) displays the blood parameter data for nursing goats fed the experimental meals. Total protein, albumin, and globulin concentrations were highest in group 3 (supplemented with 7.5 g YCW/h/day), followed by groups G4 and G2, and lowest in group G1 (P<0.05). YCW supplementation clearly raised glucose concentration (P < 0.05), with G3 showing the highest value, followed by G4 and G2, while control G1 showed the lowest value. The addition of yeast cell wall resulted in a significant (P<0.05) decrease in triglyceride and cholesterol concentrations; G3 exhibited the lowest values, followed by G4 and G2, while the control G1 showed the highest amounts. With the addition of YCW, renal function is improved as measured by urea-N and creatinine concentrations. Yeast cell wall supplementation resulted in a significant (P<0.05) decrease in urea-N and creatinine concentrations, with lower values in G3 followed by G4 and G2, whereas control G1 had the highest amounts. With YCW supplementation, liver enzyme levels of AST and ALT were considerably reduced (P<0.05), indicating better liver function. In contrast to the greater quantities found in control G1, G3 showed lower AST and ALT values, followed by G4 and G2.

Feed intake:

Table (4) displays the feed intake results for the various experimental groups. The addition of yeast cell wall led to larger intakes of concentrate feed mixture, corn silage, alfalfa, DM, TDN, CP, and DCP in G3, followed by G4 and G2, while control G1 had lower intakes. DMI, TDNI, CPI, and DCPI intakes were greater in G3 (371.48, 245.84, 47.29, and 32.43 g/h/d) than in G1 (353.41, 220.04, 44.99, and 29.03 g/h/d), respectively.

Growth performance:

The groups (G2, G3, and G4) that were fed a meal supplemented with yeast cell wall (YCW) showed significantly higher final weight, total weight increase, average daily gain (ADG), and ADG improvement compared to G1 (P<0.05), according to the findings in Table (5). Furthermore, compared to G2 (5 g/h/day), the group fed a ration supplemented with 7.5 g/h/d yeast cell wall (G3) recorded significantly greater final weight, total weight increase, average daily gain (ADG), and ADG improvement. Differences with G4 (10 g/h/day) were negligible. ADG values for G3 were 63.66 g, whereas those for G4, G2, and G1 were 60.98, 58.59, and 52.80 g, respectively. This could be because lower and higher levels of TCW are less effective than 7.5 g of YCW, which is a more effective dose to improve final weight, total weight gain, average daily gain (ADG), and ADG.

Feed conversion:

For growing kids, the feed conversion results shown in Table (6) showed a considerable (P<0.05) improvement with the addition of yeast cell wall. With the lowest amounts of DM, TDN, CP, and DCP needed per kilogram of live weight growth, followed by G4 and G2, G3 demonstrated the best feed conversion; nevertheless, G1 had the highest amounts (P<0.05). In comparison to the control G1, the addition of yeast cell wall at 7.5 g/h/d in G3 increased DM, TDN, CP, and DCP conversion by 12.76, 7.47, 12.94, and 7.27%, respectively.

Economic efficiency:

Table (4) shows the economic efficiency of goat growth as influenced by the addition of yeast cell walls. As the amount of YCW supplementation increased, the cost of feed intake per day increased significantly (P<0.05), with G4 having the highest cost (5.18 LE/day) and G1 having the lowest cost (4.05 LE/day). With YCW additive, the output of ADG increased significantly (P<0.05). G3 recorded a high value of 15.28 LE/day, which differed significantly (P<0.05) from both G1 (12.67 LE/day) and G2 (14.06 LE/day), while G4 (14.64 LE/day) differed insignificantly. In contrast, G4's production did not differ substantially (P>0.05) from both G2 and G4. Furthermore, net revenue and net revenue improvement were considerably (P<0.05) higher in G3 supplemented with 7.5 g YCW/h/day, followed by G4 and G2, while G1 had the lowest values. In comparison to G1, the net revenue of G2, G3, and G4 increased by 9.63, 19.26, and 9.74%, respectively.

Discussion

The outcomes of the digestion of nutrients are consistent with the findings reported in the literature by Cai et al. [51], who showed that adding Saccharomyces cerevisiae to goat meals significantly (P<0.05) improved the digestibility of dry matter. Furthermore, Abd-Elkader et al. [52] found that adding Saccharomyces cerevisiae to goat diets significantly improved nutritional digestibility ($P<0.05$). Dry yeast supplementation increased the digestion of nutrients [53]. A yeast addition that improves the digestion of nutrients [54]. When compared to the control group, the yeast-supplemented group's digestibility of dry matter, organic matter, crude protein, neuter detergent fiber, and acid detergent fiber was higher ($p<0.05$) [55]. For developing Friesian calves [56] and lactating buffaloes [57], supplementing with yeast resulted in a significant ($P<0.05$) improvement in the digestibility coefficients of all nutrients and nutritional values.

Ruminal fluid's pH was lowered by the Saccharomyces cerevisiae-supplemented diet [58]. Cellulolytic bacteria grow best at pH 6.7, and normal activity is maintained at pH 6.7 ± 0.5 [59]. About 80% of ruminants' energy needs are met by VFA [60]. Goats under heat stress can still benefit from rumen fermentation when given a low dose of Saccharomyces cerevisiae [22]. Goats' summertime rumen fermentation may be enhanced by a yeast culture supplement; the ideal supplementation concentration is 0.9% DMI [23].

The amount of NH3-N in the rumen of goats, cattle, and bulls was considerably reduced by yeast supplementation [10]. The concentration of TVFA in the rumen of sheep and cattle is significantly increased when they are supplemented with yeast in their diet [21]. Additionally, the YCW has the ability to control and enhance VFA production [32]. Additionally, Bakr et al. [61] observed that cattle fed the yeast-supplemented feed had higher levels of total volatile fatty acids (VFAs) and lower levels of ruminal pH and ammonia nitrogen (N) in the rumen. According to earlier research, yeast products may raise the rumen's propionate concentrations [54].

Yeast culture addition resulted in a statistically significant ($P<0.01$) drop in pH and a positive ($P<0.01$) effect on volatile fatty acid (VFA) production, while experimental groups used more ammonia ($P<0.01$) than control [62]. Ruminal propionate and total volatile fatty acid levels rose in response to a yeast addition [63]. Goats treated with yeast had considerably lower ($P<0.05$) ruminal pH and ammonia nitrogen levels and significantly higher ($P<0.05$) ruminal volatile fatty acid and molar proportion of propionate concentrations than the control [64].

The molar fraction of acetate rose ($P<0.05$) when live yeast was added to the control meal [65]. The fattening steer's ruminal pH (>6.0) stayed constant ($p > 0.05$), and dry yeast was used to keep the pH at or above 6.0. Dry yeast supplementation resulted in a decrease in butyric acid concentration and an increase ($p < 0.05$) in propionic acid concentration [53]. The rumen fluid of cows given YCW additive had a lower pH and a higher content of total VFA [66].

Zhang et al. [67] showed that adding yeast to growing bulls significantly raised the amounts of rumen acetate, propionate, and total VFA ($P < 0.05$). When compared to the control group, the proportion of butyric acid decreased and the proportion of acetic acid increased ($P < 0.01$), both of which were highly significant [58]. When yeast was supplemented for growing Friesian calves [56] and breastfeeding buffaloes [57], the ruminal pH value and NH3-N concentration dramatically dropped ($P<0.05$), whereas the ruminal TVFA concentration significantly rose ($P<0.05$). The TVFA concentrations reported in this study fall between 80 to 170 mmol/l, which is the typical range for rumen VFA concentrations [68]. Rumen pH is typically between 5.7 and 6.7, and VFA concentrations often fall between 80 and 120 mmol/liter [69].

One of the byproducts of feedstuff fermentation in the rumen is volatile fatty acids. Although the amount of VFAs in rumen fluid varies greatly between diets, it typically falls between 60 and 120 mmol/L [70, 71, 72].

Abu Goats' blood total protein and albumin concentrations were shown to be considerably ($P<0.05$) elevated by yeast supplementation, according to El-Ella and Kommonna [73]. According to Mahrous et al. [74], Zaraibi goats on a supplemented diet had significantly greater ($P<0.05$) levels of albumin, globulin, and total protein than goats fed an unsupplemented diet. Additionally, Mehrez et al. [75] discovered that, in comparison to the control lambs, yeast supplementation significantly ($P<0.05$) raised the levels of serum albumin and globulin. Calves fed yeast had higher levels of globulin and total protein in their plasma [76]. El-Shaer [77] discovered that Rahmani lambs fed diets with two roughage-to-concentrate ratios had higher glucose levels due to yeast. According to Mahrous and colleagues [74], the blood plasma of Zaraibi goats fed a supplementary diet the previous day had a higher glucose concentration ($P<0.05$). Blood glucose levels were greater in growing goats fed diets supplemented with yeast than in the control group [63]. Calves given yeast supplementation had higher glucose plasma concentrations [76]. A dietary yeast supplement can have a beneficial effect on biochemical indices and characteristics that raise the blood glucose levels of developing goats [63]. Compared to the control group, laying hens in the yeast-treated groups had considerably reduced levels of serum triglycerides and cholesterol [78]. Calves given yeast supplementation had lower levels of triglycerides and cholesterol [76]. An addition of red yeast rice extract dramatically reduced plasma levels of triglycerides and total cholesterol [79].

Regarding kidney function, Li et al. [80] discovered that feeding dairy cows yeast reduced blood urea nitrogen levels. The urea level in the blood serum of the cows in the yeast experimental group was considerably lower (P < 0.01) than that of the control group [58]. The broiler chickens on a diet supplemented with 3% yeast had the lowest serum urea value, which varied considerably (p<0.05) among the dietary treatments [81]. When compared to the no-yeast-fed group, yeast dramatically decreased the liver enzymes AST and ALT (p<0.05) [82]. In agricultural animals, elevated serum levels of the liver enzymes ALT and AST are good markers of hepatic injury [83].

Hassaan et al. [84] discovered that feeding Nile tilapia diets supplemented with 15 g/kg of yeast extract might lower their AST and ALT activity. The broiler chickens on a diet supplemented with 3% yeast had the lowest serum AST and ALT levels, which varied considerably (p<0.05) among the dietary regimens [81].

Dietary yeast supplementation had a minor effect on dry matter intake (DMI), according to similar feed intake results observed by Ogbuewu and Mbajiorgu [63]. The DMI was increased in cows given YCW additive [66]. Dry yeast supplementation increased consumption of dry matter [53]. According to Singer et al. [85], lambs fed 5.5 g of yeast had the highest dry matter intake (P<0.05) when compared to the control group (T1). DMI and TDNI rose in Zaraibi goats fed diets supplemented with 3 or 6 g/h/d of S. cerevisiae yeast culture, according to Abd El-Ghani [86]. Additionally, Gaafar et al. [57] found that breastfeeding buffaloes fed a ration consisting of 60% concentrate and 40% roughage with baker's yeast supplementation had significantly higher DMI, TDNI, CPI, and DCPI.

As shown in Table 4, G3 showed a much higher amount of feed intake than the other groups, which may be the reason for the improvement in body weight. A 4.5% dietary yeast culture boosted overall weight gain [87]. The results are in line with a study by Tripathi and Karim [88] that found that adding yeast to lamb diets caused a significant (P<0.05) increase in average daily gain (ADG) for lambs treated with yeast as opposed to the control group. Similarly, Cai et al. [51] showed that adding yeast at a rate of 0.60% to the goats' basal diet increased their daily weight gain in a statistically significant (P<0.05) way. The average daily gain (ADG) of growing goats fed SC was higher than that of the controls [63].

The feed conversion results are consistent with those of Ahmed et al. [89], who found that Zaraibi goats fed rations supplemented with yeast at 1g or 2g yeast/h/d had a higher feed conversion rate (based on DM) than the control. Mahrous et al. [74] discovered that supplementing with yeast increased the feed conversion of nursing goats. However, Gaafar et al. [57] discovered that buffaloes fed a feed that had 40% concentrate and 60% roughage with baker's yeast supplementation had superior DM, TDN, and DCP conversions than those on a ration without any supplementation.

Gaafar et al.'s [57] findings that buffaloes fed rations enhanced with baker's yeast showed improved economic efficiency. Additionally, Mahrous et al. [74] found that giving nursing goats live yeast increased their economic efficiency compared to feeding them an unsupplemented meal. According to Abou-Aiana et al. [56], adding yeast to the diets of developing Friesian calves resulted in a significant (P<0.05) rise in the average daily feed cost, feed cost per kg gain, and price of daily weight gain. Supplementing with baker's yeast resulted in a significant increase in economic efficiency (P<0.05) [57].

Conclusion

From the results of this study, it could be concluded that the addition of 7.5 g/kid/day of yeast cell walls in diets of growing kids revealed the better results, which have a significant positive impact on the blood serum biochemicals, digestion, rumen fermentation activity, feed intake, growth performance, feed conversion, and economic efficiency.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

The experiments were performed according to the guidelines of a local ethics committee for animal care and welfare (Number 08/2016EC).

TABLE 1. Chemical composition of ingredients and total mixed diet.

Item	DM %	Composition of DM %								
		OM	CP	CF	EE	NFE	Ash	NDF	ADF	ADL
CFM	89.97	91.13	14.27	11.85	2.98	59.03	8.87	38.15	28.96	3.87
CS	32.33	93.16	7.65	23.37	2.76	64.38	6.84	44.60	25.35	3.24
AH	88.22	84.35	13.52	27.96	2.55	40.32	15.65	43.76	31.28	9.56
TMD	62.10	90.62	12.73	17.14	2.86	57.89	9.38	40.60	28.41	4.56

CFM: concentrate feed mixture, CS: corn silage, AH: alfalfa hay, TMD: total mixed diet, DM: dry matter; OM: organic matter; CP: crude protein; CF: crude fiber; EE: ether extract; NFE: nitrogen free extract, NDF: neutral detergent fiber, ADF: acid detergent fiber, ADL: acid detergent lignin. Total mixed diet = 60% CFM, 25% CS, 15% AH.

TABLE 2. Nutrients digestion and nutritional values of growing kid's diet with different levels of yeast cell walls.

Item	Treatment groups				SE
	G1	G2	G3	G4	
Digestion coefficients %					
DM	63.38^{c}	65.27^{b}	67.40^{a}	66.31^{ab}	0.44
OM	64.82^{c}	66.75^{b}	68.90^{a}	67.82^{ab}	0.45
CP	64.50^{c}	66.42^{b}	68.56^{a}	67.48^{ab}	0.46
CF	62.55^{c}	64.41^{b}	66.49^{a}	65.45^{ab}	0.44
EE	78.43^{c}	80.77^{b}	83.37^{a}	82.06^{ab}	0.55
NFE	66.12^{c}	68.09^{b}	70.28^{a}	69.18^{ab}	0.46
Nutritional values %					
TDN	62.23^{c}	64.09^{b}	66.15^{a}	65.11^{ab}	0.43
DCP	8.21^{c}	8.45^{b}	8.73^{a}	8.59^{ab}	0.06

[a,b,c:] Values in the same row with different superscripts differ significantly at P<0.05.
OM: organic matter; CP: crude protein; CF: crude fiber; EE: ether extract; NFE: nitrogen free extract; TDN: total digestible nutrients; DCP: digestible crude protein.
G1: 0 YCW, G2: 5 gm YCW, G3: 7.5 gm YCW, G4: 10 gm YCW.

TABLE 3. Rumen fermentation activity and blood serum biochemicals as affected by different levels of yeast cell walls supplementation.

Item	Treatment groups				SE
	G1	G2	G3	G4	
Rumen fermentation					
pH value	6.73^{a}	6.58^{ab}	6.37^{c}	6.49^{bc}	0.04
TVFA's, mmol/l	87.94^{c}	101.86^{b}	119.57^{a}	108.71^{b}	2.97
NH_3-N, mg/dl	19.13^{a}	17.10^{b}	14.66^{c}	15.70^{bc}	0.44
Acetic acid, mmol/l	46.33^{c}	53.66^{b}	62.99^{a}	57.27^{b}	1.57
Propionic acid, mmol/l	28.78^{c}	33.33^{b}	39.12^{a}	35.57^{b}	0.97
Butyric acid, mmol/l	10.26^{a}	9.06^{b}	7.53^{c}	8.29^{bc}	0.27
Blood serum biochemicals					
Total protein, g/dl	7.26^{c}	7.43^{bc}	7.80^{a}	7.63^{ab}	0.06
Albumin, g/dl	3.83^{c}	3.92^{bc}	4.12^{a}	4.04^{ab}	0.03
Globulin, g/dl	3.42^{c}	3.51^{bc}	3.68^{a}	3.59^{ab}	0.03
Triglyceride, mg/dl	62.21^{a}	52.35^{ab}	39.49^{c}	45.81^{bc}	2.53
Cholesterol, mg/dl	72.71^{a}	67.34^{ab}	58.85^{c}	64.17^{bc}	1.51
Glucose, mg/dl	55.46^{c}	62.32^{bc}	70.09^{a}	65.18^{ab}	1.65
Urea-N, mg/dl	10.13^{a}	8.55^{ab}	6.69^{c}	7.66^{bc}	0.40
Creatinine, mg/dl	0.89^{a}	0.83^{ab}	0.71^{c}	0.79^{bc}	0.02
AST, U/L	65.36^{a}	58.80^{b}	51.96^{c}	56.64^{bc}	1.48
ALT, U/L	21.80^{a}	17.15^{b}	12.90^{c}	14.57bc	0.95

[a,b,c:] Values in the same row with different superscripts differ significantly at P<0.05.
TVFA's: total volatile fatty acids, NH_3-N: ammonia nitrogen, Urea-N: urea nitrogen, AST: aspartate aminotransferase, ALT: alanine aminotransferase.
G1: 0 YCW, G2: 5 gm YCW, G3: 7.5 gm YCW, G4: 10 gm YCW.

TABLE 4. Average daily feed intake as affected by different levels of yeast cell walls supplementation.

Item	Treatment groups			
	G1	G2	G3	G4
Concentrate feed mixture as fed, g	235.68	240.37	247.74	244.39
Corn silage as fed, g	273.28	278.72	287.26	283.27
Alfalfa hay as fed, g	60.09	61.28	63.16	62.31
TDM, g	353.41	360.44	371.48	366.46
TDN, g	220.04	231.07	245.84	238.72
CP, g	44.99	45.88	47.29	46.65
DCP, g	29.03	30.49	32.43	31.49

DM: dry matter; TDN: total digestible nutrients; CP: crude protein; DCP: digestible crude protein.
G1: 0 YCW, G2: 5 gm YCW, G3: 7.5 gm YCW, G4: 10 gm YCW.

TABLE 5. Growth performance of growing kid's **diet with different levels of yeast cell walls.**

Item	Treatment groups				SE
	G1	G2	G3	G3	
Initial weight, kg	8.32	8.30	8.34	8.35	0.05
Final weight, kg	16.24[c]	17.09[b]	17.89[a]	17.50[ab]	0.18
Total weight gain, kg	7.92[c]	8.79[b]	9.55[a]	9.15[ab]	0.15
Average daily gain, g/day	52.80[c]	58.59[b]	63.66[a]	60.98[ab]	1.00
ADG improvement, %	00.00[c]	10.92[b]	20.52[a]	15.45[ab]	1.74

[a,b,c:] Values in the same row with different superscripts differ significantly at $P<0.05$.
ADG: average daily gain, ADG improvement % = (ADG of G2, G3-ADG of G1) or G4 × 100/ADG of G1.
G1: 0 YCW, G2: 5 gm YCW, G3: 7.5 gm YCW, G4: 10 gm YCW.

TABLE 6. Feed conversion and economic efficiency as affected by different levels of yeast cell walls supplementation.

Item	Treatment groups				SE
	G1	G2	G3	G4	
Feed conversion					
DM, kg/kg gain	6.66[a]	6.13[b]	5.81[b]	5.99[b]	0.09
TDN, kg/kg gain	4.15[a]	3.93[ab]	3.84[b]	3.90[b]	0.05
CP, kg/kg gain	0.85[a]	0.78[b]	0.74[b]	0.76[b]	0.02
DCP, kg/kg gain	0.55[a]	0.52[ab]	0.51[b]	0.51[b]	0.01
Economic efficiency					
Feed cost, LE/day	4.05[c]	4.61[b]	5.00[ab]	5.18[a]	0.12
Output of ADG, LE/day	12.67[c]	14.06[b]	15.28[a]	14.64[ab]	0.21
Net revenue, LE/day	8.62[c]	9.45[b]	10.28[a]	9.46[b]	0.15
Net revenue improvement, %	00.00[c]	9.63[b]	19.26[a]	9.74[b]	1.58

[a,b,c:] Values in the same row with different superscripts differ significantly at $p<0.05$.
DM: dry matter; TDN: total digestible nutrients; CP: crude protein; DCP: digestible crude protein. Prices in Egyptian pound (LE) during 2020 were LE 14000/ton concentrate feed mixture, LE 1500/ton corn silage, LE 6000/ton alfalfa hay, yeast cell wall 400 LE/kg, live body wight of kids 240 LE/kg. Net revenue improvement %= (net revenue of G2, G3 or G4 – net revenue of G1) ×100/ net revenue of G1.
G1: 0 YCW, G2: 5 gm YCW, G3: 7.5 gm YCW, G4: 10 gm YCW.

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تأثير إضافة جدر خلايا الخميرة على الهضم، وتخمرات الكرش، وبعض مكونات الدم، وأداء النمو لجديان الماعز البلدي

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الملخص

تستخدم جدر خلايا الخميرة بشكل شائع كمكمل غذائي في النظام الغذائي للحيوانات، وتحتوي على نوعين رئيسيين من السكريات المتعددة، هما: مانان أوليجوساكاريد وبيتا جلوكان. استُخدم في هذه الدراسة أربعة وعشرون ذكرًا من الماعز البلدي النامي، بمتوسط عمر ثلاثة أشهر ووزن 8.33 ± 0.05 كجم، لدراسة تأثير إضافة جدر خلايا الخميرة على أداء نمو جديان الماعز. غذِّيت الجديان على عليقة متكاملة الخلط تتكون من 60% مخلوط علف مركز، و25% سيلاج ذرة، و15% دريس برسيم. تم تقُسِّيم الجديان عشوائيًا إلى أربع مجموعات متماثلة، كل مجموعة بها ستة جديان. غذيت المجموعات التجريبية العليقة متكاملة الخلط مع جدر خلايا الخميرة بمستويات 0، 5، 7.5، و10 جم/رأس/يوم للمجموعات الأولى والثانية والثالثة والرابعة على التوالي. أدت إضافة جدر خلايا الخميرة إلى تحسن ملحوظ في هضم جميع العناصر الغذائية، والقيم الغذائية، وتخمر الكرش، والكيمياء الحيوية في مصل الدم، وكمية الغذاء المأكولة، وأداء النمو، ومعدل التحويل الغذائي، والكفاءة الاقتصادية مقارنةً بمجموعة المقارنة. حققت المجموعة الثالثة، التي تلقت 7.5 جرام/رأس/يوم، أعلى قيم لهضم جميع العناصر الغذائية، والقيم الغذائية، وتركيزات الأحماض الدهنية الطيارة الكلية، والأسيتات، والبروبيونات في الكرش، والبروتين الكلي، والألبومين، والجلوبيولين، والجلوكوز في سيرم الدم، والوزن الحي النهائي، والزيادة الكلية في وزن الجسم، ومتوسط الزيادة اليومية، ومعدل التحويل الغذائي والكفاءة الاقتصادية. حيث أظهرت المجموعة الثالثة أعلى مأكول من المادة الجافة (DM)، والمركبات الغذائية الكلية المهضومة (TDN)، والبروتين الخام (CP)، والبروتين الخام المهضوم (DCP)، والعائد الاجمالى والصافى ($P<0.05$). بينما أظهرت المجموعة الثالثة أيضا بشكل ملحوظ أدنى قيم للأس الهيدروجيني، وتركيزات نيتروجين الأمونيا، والبيوترات في الكرش، وتركيزات الدهون الثلاثية، والكوليسترول، ونيتروجين اليوريا، والكرياتينين، وأنزيمات الكبد (AST&ALT) في سيرم الدم ($P<0.05$). نستخلص من هذه الدراسة أن إضافة جدر خلايا الخميرة بمستوى 7.5 جرام / رأس / يوم في عليقة الماعز النامية لها تأثيرات مفيدة وملحوظة على الهضم، وتخمرات الكرش، وبعض مكونات سيرم الدم، والغذاء المأكول، وأداء النمو، ومعدل التحويل الغذائى، والكفاءة الاقتصادية.

الكلمات الدالة: جدر خلايا الخميرة، الجديان النامية، الأداء الإنتاجي، الكفاءة الاقتصادية.