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Research Article

Impact of Yeast and/or Exogenous Fibrolytic Enzymes-Treated Olive Trees By-Products on Digestibility and Ruminal Fermentation of Damascus Goat Bucks

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Abstract:

Agro-waste from olive trees (OTB) which is not properly utilized and left it without treatment may lead to major social, environmental and economic problems. Such wastes can be biologically treated to increase their nutritive values and be utilized as ruminant alternative feeds. Investigate if their synergism between live yeast culture and Exogenous fibrolytic Enzymes (EFE) and impact of each of them or their mixture on OTB digestibility, nutritional values, nitrogen utilization and some ruminal fermentations are the main objectives of this study. Damascus goat bucks were randomly assigned into five groups of three animals each using complete random design. Goats were fed, 70% concentrate feed mixture (CFM)+ 30% berseem hay (control group), 70% CFM+ untreated olive trees by-product as a replacer for berseem hay (R1), 70% CFM+30% OTB treated with EFE (R2), 70% CFM+30% OTB treated with live yeast culture (R3) and 70% CFM+30% OTB treated with a mixture of EFE and live yeast culture (R4). Synergism was noted between live yeast culture and exogenous fibrolytic Enzymes (EFE) on the tested parameters. Results indicated that addition either as live yeast culture or exogenous fibrolytic enzymes increased ($P<0.05$) the digestibility of all nutrients which were reflected on the nutritive values (as TDN and DCP) of olive trees byproducts. Addition of live yeast culture or exogenous fibrolytic enzymes reduced ammonia-N and increased both TVFA's. Inclusion of biologically treated olive tree by products (OTB) in Damascus bucks rations improved nutritive value and ruminal activity.

1. Introduction

In Egypt, there is a serious gab between the necessary and available feed ingredients for livestock. An estimated 3.1 million tons of total digestible nutrients are lost annually due to this feedstuff deficit (Fayed et al., 2009). Additionally, roughage feed supplies are the foundation of small ruminant nutrition in Egypt (Azzaz et al., 2012). The low productivity of local livestock and the ongoing price increases for traditional roughages prompted nutritionists to look for alternate feed sources (Azzaz et al., 2017). In this regard, only 15% of the approximately 30 million tons of by-products produced by agricultural and agro industrial operations are utilized for animal feed (Fadel and El-Ghonemy, 2015).

When leaves and twigs from olive trees (OTB) are not used effectively and are not treated, they can lead to major problems from an economic, social, and environmental perspective. Fayed et al. (2009) revealed that each olive tree yields about 22 kilogramme of leaves a year. According to the Egyptian Ministry of Agriculture and Land Reclamation, the fertile area of olive trees reached 257,000 feddan. (Ministry of Agriculture and Land Reclamation, 2024). These enormous quantities of olive tree byproducts (OTB) may be used as ruminant roughage substitutes (Fayed et al., 2009). The origin, storage and climate conditions, moisture content, and degree of lignification all affect OTB's chemical composition (Hend, 2009). 50–60% dry matter, 7–11% crude protein, 5-7% ether extract, 13-23% crude fiber, 53-59% nitrogen free extract, 40–45% neutral detergent fiber, 28–35% acid detergent fiber, and 18–20% acid detergent lignin are all present in the air-dried OTB (Hend, 2009). Additionally, the leaves are low in tyrosine and cysteine and high in arginine, glutamic, leucine, aspartic and valine amino acids. Furthermore, the main fatty acids in the crude fat of olive leaves are palmitic and linolenic acids (Lee et al., 2005).

Low protein and high fiber concentrations, as well as the presence of anti-nutritional components (such tannins), which may contribute to OTB's poor palatability and digestibility, are the primary barriers to expanding the inclusion of OTB in ruminant diets, as is evident from the chemical composition. Therefore, it is necessary to break the chemical connections between lignin, cellulose, and hemicellulose in order to increase the nutritional value of OTB as a lignocellulolytic substance (Azzaz et al., 2016; Kholif et al., 2018). Numerous techniques, including biological, mechanical and chemical treatments, have been proposed to achieve that (Hend, 2009). Without having an adverse effect on the health of the animals, the microbiological treatments enhanced the nutritional value of the agricultural waste (Aboul-Fotouh et al., 2016).

Exogenous fibrolytic enzymes (EFE) and live yeast culture have both been employed recently to increase the utilization efficiency of poor-quality roughages. Numerous investigations have demonstrated the beneficial effects of EFE supplementation on microbial populations, fibrolytic activity of rumen liquor, and rumen characteristics. (Gaafar et al., 2010; Bhasker et al., 2013). Additionally, studies have shown that adding

live yeast culture to the diets of cattle, sheep, and goats alters rumen fermentation and stimulates ruminal digestion (Mahender et al., 2006; Srinivas Kumar et al., 2011). Additionally, a number of attempts have been undertaken to feed dairy animals a combination of probiotic formulations (Erasmus et al., 2005), presuming that they have a synergistic effect on animal health and productivity.

A synergistic effect was expected as yeast can make the ruminal environment more suitable for optimum feed digestion (Elghandour et al., 2015[a]). At the same time, the inclusion of dietary exogenous enzymes in the diet of ruminants could enhance feed utilization (Morsy et al., 2016).

The impact of adding live yeast culture and/or EFE on rumen fermentation, however, has only been described in a small number of comparative studies. Thus, assessing the impact of treating OTB with live yeast culture and/or EFE on nutrient digestibility, nutritional values, and some ruminal fermentation was the aim of the experiment.

2. Materials and Methods

This study was conducted in El-Gemiza, Animal Production Research Station belonging to the Animal Production Research Institute, Agricultural Research Centre, Egypt. The olive trees by products (leaves and twigs) were collected from olive farms along Matrouh Road, then chopped and dried naturally for 2 weeks and packed till use. Fifteen Damascus goat bucks were divided into five similar groups (three animals each). Damascus goat bucks were fed on one of the following ration:

Animals in the first group was fed control ration consisted of 70% concentrate feed mixture (CFM: 60% corn, 22% soybean meal, 15% wheat bran,1% limestone, 1% minerals and vitamins mixture and 1% NaCl)+30% berseem hay (control group), The second group (UOTB) was fed on 70%CFM + untreated olive trees by-product as a replacer for berseem hay (R1). The third group was fed R2 ration (70% CFM+30% OTB treated with EFE preparation (Fibrozyme^{TM}, 4 g/day) containing a composite of active xylanase and cellulase). The fourth group was fed R3 ration (70% CFM+30% OTB treated with a live yeast culture preparation (Yea – Sacc^{1026}, 4 g/h/day) containing dried live yeast culture (*Saccharomyces cerevisiae*^{1026}), while the last group was fed R4 ration (70% CFM+30% OTB treated with 8 g/h/day exogenous enzymes and live yeast culture mixture. Diets were offered to each animal individually at 08:00 and 16:00 h in two equal portions.

Table 1. Impact of EFE and live yeast culture treatment on the chemical composition of olive Tree by-products.

Item	UOTB	OTBE	OTBY	OTBYE	BH
Chemical analysis (g/kg DM)					
DM	880.4	893.2	914	930.7	905
OM	840	844.8	852.3	860.1	883.2
Ash	160	155.2	147.7	139.9	116.8
CP	60.3	110	125	152.7	138.5
CF	230.2	160.5	151.7	132.3	315.2
EE	52	59.2	58.8	59.9	22.7
NFE	497.5	515.1	516.8	515.2	406.8
Cell wall constituents (g/kg DM)					
NDF	530.7	510.2	492.5	448.3	439.2
ADF	390.1	382.5	377.2	370.1	362
ADL	125.2	112.1	102.7	88.3	70.2
Cellulose	264.9	270.4	274.5	281.8	291.8
Hemicellulose	140.6	127.7	115.3	78.2	77.2

UOTB, untreated olive Trees by products; OTBY, Olive Trees by products treated with live yeast culture; OTBE, Olive Trees by products treated with EFE; OTBYE, Olive Trees by products treated with both of Live yeast culture and EFE; BH, Berseem hay

2.1. Digestibility and nitrogen balance trials

Digestibility and nitrogen balance trials were carried out using Fifteen Damascus goat bucks (57.6 ±1.33, in average) (three bucks for each group). Trial lasted for four weeks; the first three weeks were as a preliminary period, followed by one week for feces and urine collection. Animals were fed twice daily at 8 am and 3 pm, water was offered freely. Each animal was offered the experimental rations according to NRC, (2007). Chemical composition of feeds, feces and urine were determined according to AOAC (2005) methods. Sub samples (20%) of feces and urine were taken once daily then stored at – 18 ºC until analyses. Fecal samples were dried at 60 ºC for 72 hrs. Feed and fecal samples were ground through 1 mm screen on a Wiley mill grinder and a sample of 50 gm/ (ration/bucks) was taken for analysis. The samples of feed and feces were analyzed for crude protein (CP), crude fiber (CF), ether extract (EE) and ash, while the urine samples were analyzed for nitrogen (N) content according to AOAC (2005). Cell wall constituents (NDF, ADF and ADL) were determined according to VanSoest (1991). Hemicellulose and cellulose were calculated by differences.

Table 2. Chemical composition of the experimental rations (g/kg of DM)

Item	CFM	Control	R1	R2	R3	R4
Chemical composition						
DM	936.1	927.8	923.2	928.5	933.9	937.1
OM	919.7	910.1	890.8	899.1	901.9	903.5
Ash	80.3	89.9	109.2	100.9	98.1	96.5
CP	122.0	128.5	106.7	128.9	126.3	129.4
CF	112.9	187.2	153.6	143.3	132.9	128.7
EE	30.2	28.7	33.1	38.7	38.9	39.3
NFE	654.6	565.7	597.4	623	603.8	606.1
Cell wall constituents						
NDF	304.9	349.5	375.9	358.6	347.2	344.8
ADF	177.1	233.2	238.6	233.1	231.2	222.8
ADL	66.3	68.4	87.3	78.9	76.8	72.4
Cellulose	110.8	164.8	151.3	154.2	154.4	150.4
Hemicellulose	127.8	116.3	137.3	125.5	116.0	122.0

CFM, concentrated feed mixture; control; group fed 70% concentrate feed mixture (CFM) + 30%berseem hay; R1, group fed 70% concentrate feed mixture (CFM) +30% untreated olive trees by products; R2, group fed 70% concentrate feed mixture (CFM) +30% olive trees by products treated with EFE ; R3, group fed 70% concentrate feed mixture (CFM) +30% olive trees by products treated with live yeast culture; R4, group fed 70% concentrate feed mixture (CFM) +30% olive trees by products treated with live yeast culture and EFE; 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

2.2. Rumen fermentation trials

Rumen samples were collected by a stomach tube at 3 hours post-feeding. Ruminal pH was measured immediately after collection using a digital pH meter (Sophisticated microprocessor, pH meter). Rumen fluid was strained through four layer of cheesecloth into plastic containers and kept frozen for later analysis. Half of the samples were acidified using concentrated ortho-phosphoric acid and 0.1N hydrochloric acid to determine the volatile fatty acids (VFA). The second half of samples was alkalized using 0.1N NaOH to determine the concentration of rumen ammonia.

2.3. Statistical analysis

The obtained data were statistically analyzed for one-way ANOVA using SAS software (SAS, 2006). The experimental model was:

$$Y\,ij = M + Ti + eij,$$

Where: Y *ij* = experimental observation; M = general mean; T*i* = effect of treatment; e*ij*= experimental error; Duncan's multiple tests were applied for comparison of means (Duncan, 1955).

3. Results and Discussions

3.1. Feed intake and Nutrient digestibilities

The results presented in Table (3) showed that intake DM was significant (P< 0.05) among treatments. The observed significant increase in the daily feed intake in all groups fed OTB treated with EFE, live yeast culture or live yeast culture and EFE mixture may be due to the significant decrease in OTB fibrous content and the improvement in fiber digestibility. The ration R3 exhibits the highest feed intake (1242.10g/h/d) without any significant differences between R2 and R4, while the control group has the lowest (1150.19 g/h/d).

Unlike to these results, Hong and Gallagher (1994) revealed that sheep fed ration with or without Sc (5 g/h/day) showed no significant differences between control and treatment in in-vivo digestibility of DM, acid detergent fiber (ADF), nitrogen (N) or in vitro DM digestibility. Also, Titi *et al.* (2008) observed that supplementation of yeast culture in the diets of lambs and kids had no effect on dry matter intake (DM).

Rations containing treated OTB with live yeast culture and EFE combination (R4) increased ($p<0.05$) all nutrients digestibility and cell wall constituents (NDF, ADF, lignin) digestibility compared to other groups (Table 3). There was no significant differences were found between R2 and R3 in all nutrients digestibility. No significant differences were found among treatments of NFE digestibility. Also, no significant differences were found between rations treated OTB and UOTB of EE digestibility. The higher apparent digestibility coefficient with R4 rations may be due to the improvement of their digestibility and absorption. These findings are supported by results of many researchers, whom reported that fiber content, specifically the NDF have a great influence on the intake and digestibility of roughages by small ruminants (Go´mez Cabrera et. al., 1982; Harper and McNeill, 2015).

Enhancement of fiber digestion and rumen environment are among the benefits of exogenous enzyme (Morsy et al., 2016) and yeast (Hassan et al., 2016) feeding to ruminants. Enhancement of nutrient digestion in this study is consistent with earlier studies in which greater nutrient digestibility resulting from en-

zyme (Rojo et al., 2015) and yeast (Hassan et al., 2016) supplement has been recorded. Enhanced ruminal fermentation with ingestion of the exogenous enzymes and yeast is arguably the predominant factor for the observed improvement in digestibility of the nutrients, in particular, dietary fiber content. Enhanced nutrient digestibility with the exogenous enzymes is attributed to its contents of cellulose and xylanase. Exogenous fibrolytic enzyme increases the rate of digestion of fiber in the rumen (Yang et al., 1999), reduces digesta viscosity (Hristov et al., 2000) and alters ruminal fermentation (Khattab et al., 2011). Wang et al. (2001) found greater attachment and colonization of ruminal bacteria on feed particles when supplemented with exogenous enzymes. Eun et al. (2007) found synergy between ruminal endogenous and exogenous enzymes with greater hydrolytic activity in the rumen. In a different experiment, exogenous enzyme supplementation enhanced populations of both ruminal fibrolytic and non-fibrolytic bacteria (Wang et al., 2001), which led to more microbial biomass and increased polysaccharidase activity. Enhanced nutrient digestibility with the addition of yeast can be explained by the fact that it scavenges oxygen from the surface of newly ingested fresh feeds, hence lowering rumen redox potential (Chaucheyras-Durand et al., 2008). Such actions make the ruminal habitat anaerobic, suitable for ruminal microbial activity (Newbold et al., 1996). Moreover, yeast cells also have soluble compounds like organic and amino acids, peptides and vitamins necessary for efficient ruminal bacteria growth and activity (Chaucheyras-Durand et al., 2008). Earlier research has shown higher total ruminal bacteria and cellulolytic bacteria populations with S. cerevisiae supplementation in buffalo calf diet and lactating cow diet, respectively (Harrison et al., 1988).

Table 3. Effect of yeast and/or exogenous fibrolytic enzymes -treated olive trees by-products on feed intake and digestibility coefficient

Items	Experimental groups				
	Control	**R1**	**R2**	**R3**	**R4**
			Feed intake (g/h/d)		
Total feed intake	1150.19±5.82^{c}	1196.76±2.37^{b}	1212.62±2.2^{ab}	1242.10±7.9^{a}	1230.21±20.15^{a}
			Digestibility (%)		
DM	57.56±1.22^{b}	58.15±1.39^{b}	63.18±0.67^{a}	62.28±0.7^{a}	62.22±0.69^{a}
OM	57.77±1.14^{c}	60.44±0.41^{b}	61.38±0.78^{ab}	64±0.25^{a}	64.79±0.34^{a}
CP	61.25±0.49^{b}	62.94±0.43^{b}	63.87±0.82^{ab}	64.36±1.83^{ab}	66.74±0.4^{a}
CF	57.55±0.53^{c}	62.47±0.75^{b}	63.51±0.61^{b}	63.12±0.99^{b}	65.74±0.4^{a}
EE	57.34±0.63^{b}	60.69±0.59^{a}	61.52±1.19^{a}	63.7±1.31^{a}	63.65±0.28^{a}
NFE	60.55±0.75^{a}	61.2±1.48^{a}	62.9±0.4^{a}	63.63±0.63^{a}	60.65±2.1^{a}
			Cell wall constituents (%)		
NDF	57.23±0.185^{c}	61.04±0.487^{b}	62.29±0.023^{a}	62.37±0.095^{a}	62.94±0.411^{a}
ADF	42.4±0.278^{c}	45.34±2.07^{bc}	47.5±0.311^{ab}	47.82±0.409^{ab}	49.72±0.288^{a}
Lignin	31.57±0.193^{e}	35.73±0.163^{d}	37.55±0.262^{c}	38.47±0.193^{b}	39.24±0.178^{a}

a,b,c,d,e: means in the same row followed by different superscripts are significantly (P<0.05) different
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

3.2. Nutritive values

Nutritive values expressed as TDN, DCP, DE and ME were (P<0.05) increased by supplementation of live yeast culture and EFE mixture (R4) compared to other treatments (Table 4). The bucks fed treated rations with additives showed superiority in nutritive values over those fed untreated ration (R1) and control. The improved TDN and DCP might be due to the higher nutrients digestibility of OTBYE groups (R4). These results are in accordance with Abou-Seri et al. (2020) who found that the TDN and DCP were significantly increased by added yeast culture plus enzymes group. However, the improvement in nutrients digestibility in relation to treatment of live yeast culture and EFE mixture, was accompanied by the improvement in the nutritive value of the given diet expressed either as Kcal metabolizable energy (ME) or as digestible crude protein (DCP) (Roth et al., 1992).

3.3. Nitrogen utilization

The data of nitrogen intake in table (5) showed that significant differences were found among treatments of nitrogen intake. The presented results indicated that dietary the R4 ration (P<0.05) increased the nitrogen retained (NR), N retained as % of N-intake and as % of N-absorbed compared to other groups. Supplement of live yeast culture or EFE significantly (P<0.05) increased the nitrogen absorbed (NA) compared to control group and R1. However, all rations were showed positive retained N. Differences in nitrogen retained values may be due to the differences in amino acids composition of protein sources and its digestibility. The higher percentage of dietary nitrogen retained noticed with ration supplemental live yeast culture and EFE mixture or live yeast culture alone compared with the control, these may be due to the more digestible protein; it had more (P<0.05) nitrogen utilization. Dietary nitrogen utilization (% N retained of N-intake) was obviously higher (P<0.05) with ration supplemented with live yeast culture and EFE mixture (R4) or live yeast culture (R3) than the all other rations.

Table 4. Effect of yeast and/or exogenous fibrolytic enzymes -treated olive trees by-products on the nutritive values in goats fed the experimental rations.

Items	Experimental Groups				
	Control	**R1**	**R2**	**R3**	**R4**
TDN, %	56.66±0.034^{e}	59.65±0.028^{d}	60.61±0.005^{bc}	60.72±0.057^{b}	61.90±0.011^{a}
TDNI, g	652.02±0.398^{e}	713.6±0.345^{d}	734.97±0.069^{c}	754.2±0.717^{b}	761.5±0.142^{a}
DCP, %	6.71±0.017^{d}	6.99±0.028^{c}	7.23±0.017^{b}	7.29±0.046^{ab}	7.40±0.057^{a}
DCPI, g	77.22±0.199^{d}	83.62±0.345^{c}	87.67±0.209^{b}	90.55±0.573^{a}	91.04±0.71^{a}
DE (M cal/kg)	2.49±0.0017^{e}	2.62±0.0014^{d}	2.67±0.0003^{c}	2.67±0.0026^{b}	2.72±0.0003^{a}
ME (Mcal kg^{-1})	2.06±0.0011^{e}	2.17±0.0011^{d}	2.2±0.0003^{c}	2.2±0.002^{b}	2.25±0.0005^{a}

$^{a,b,c,d,e:}$ *means in the same row followed by different superscripts are significantly (P<0.05) different*

Table 5. Effect of yeast and/or exogenous fibrolytic enzymes -treated olive trees by-products on nitrogen utilization

Items	Experimental groups				
	Control	**R1**	**R2**	**R3**	**R4**
Nitrogen intake (NI), g/d	19.12±0.005^{e}	19.44±0.023^{d}	19.56±0.034^{c}	19.88±0.017^{b}	19.99±0.011^{a}
Nitrogen absorbed (NA), g/d	13.01±0.011^{c}	13.07±0.04^{c}	13.23±0.005^{b}	13.40±0.028^{a}	13.48±0.046^{a}
Nitrogen retained (NR), g/d	4.75±0.028^{d}	4.98±0.017^{c}	5.22±0.011^{b}	5.43±0.017^{a}	5.48±0.046^{a}
N- retained e as % of N-intake	24.84±0.144^{d}	25.62±0.057^{c}	26.69±0.011^{b}	27.31±0.063^{a}	27.41±0.216^{a}
N- retained as % of N-absorbed	36.51±0.19^{d}	38.10±0.014^{c}	39.46±0.072^{b}	40.52±0.04^{a}	40.65±0.202^{a}

$^{a,b,c,d,e:}$ *means in the same row followed by different superscripts are significantly (P<0.05) different*

3.4. Ruminal fermentation

Ruminal pH and ruminal metabolites (NH3-N and TVFA's) values were significantly affected by supplementation of live yeast culture and EFE (Table 6). The pH value of rumen liquor were significantly (P<0.05) decreased by treatment of olive trees byproducts with live yeast culture or EFE or their both compared with UOTB (R1) and control group. The pH values are within the normal range obtained by Van Soest (1982) who stated that the optimum pH value for growth of cellulytic microorganisms was 6.7±0.5 pH degree.

These results differenced with the findings of Can et al. (2007) and Poonooru et al. 2015 who found that supplementation of both EFE and live yeast culture in TMR increased *(P*<0.01) the rumen pH as compared to the control demonstrating the additive effect. In contrast, LopuszanskaRusek and Bilik (2011) reported that supplementation of both EFE and live yeast culture in rations of dairy cows had no effect *(P*>0.05) on rumen pH, in addition, most of the researchers reported that EFE supplementation had no effect on rumen pH (Pinos-Rodriguez et al., 2008; Singh and Das, 2009; Ganai et al., 2011; Bhasker et al., 2013; Lara Bueno et al., 2013; Torres et al., 2013). These results incorroborated with the earlier reports of Garg et al. (2009), Ibrahim et al. (2012), Raj Kiran and Srinivas Kumar (2013), and Nehra et al. (2014) who found that supplementation of live yeast culture in TMR increased *(P*<0.01) the rumen pH as compared to the control.

Supplemental with live yeast culture and EFE combination had significantly (P<0.05) decreased the NH3-N compared to UOTB and control group. While, the concentrations of TVFA's significantly increased (P<0.05) with OTBYE ration (R4) compared to other rations. This increase in TVFA's may be due to the increase of apparent digestibility of organic matter. The decrease of ruminal NH3-N concentration with OTBYE ration may be due to improve of the rumen microbe's activity utilizing NH3-N to produce microbial protein, in the meantime, improve degradation of feed utilization (Froetschel, 1990).

The higher concentrations of TVFA in the rumen fluid could be attributed to stimulatory effect of yeast culture on viable and total bacterial population, which in turn enhanced the fermentation in the rumen and resulted in increased production of TVFA (Gurpreet Singh et al., 2008). These observations are very consistent with the findings of Ibrahim et al. (2012), Raj Kiran and Srinivas Kumar (2013), Nehra et al. (2014), and Ganai et al. (2015).

Yeast and yeast-enzyme mixture reduced the ruminal ammonia-N concentrations, indicating the potential of S. cerevisiae to alter microbial N metabolism. It is possible that the number or activity of proteolytic bacteria was lowered in the goat rumen treated with S. cerevisiae, as noted by Elghandour et al (2015^{b}). Lower ammonia-N levels with greater nutrient digestibility at the same moment, is a sign of a balance between soluble N and carbohydrate availability, leading to increased microbial growth and reduced N loss. The current findings agree with those of Al Ibrahim et al. (2010). Protease activity in EZ treatment can be accountable for increased ammonia-N concentration due to enhanced protein degradation (Togtokhbayar et al., 2015). Higher VFA concentrations with the treatment of the exogenous enzymes and yeast may be due to better nutrient digestion, since VFA concentrations are reliant on feed digestibility, rate of absorption, and activity of ruminal microflora (Flatt et al., 1956).

Table 6. Effect of yeast and/or exogenous fibrolytic enzymes -treated olive trees by-products on some ruminal fermentation

Overall mean	Control	R1	R2	R3	R4
pH	6.69±0.006[a]	6.55±0.003[b]	6.46±0.001[d]	6.48±0.001[c]	6.47±0.001[d]
NH3-N mg/100 ml	15.15±0.011[a]	12.83±0.01[b]	12.69±0.008[c]	12.44±0.012[d]	12.29±0.005[e]
VFAs mg/100 ml	10.48±0.004[e]	11.5±0.019[d]	11.59±0.01[c]	11.74±0.012[b]	12.24±0.011[a]

[a,b,c,d,e:] *means in the same row followed by different superscripts are significantly (P<0.05) different*

4. Conclusions

From the present study it can be concluded that dietary supplement either live yeast culture and/ or EFE to the diet, showed beneficial supplement effects to improve nutritive value olive trees by-products of and ruminal activity of Damascus bucks .

5. References

AOAC, (2005) Official methods of analysis, 18th ed. Association of Official Analytical Cheists, Washington, DC.

Aboul-Fotouh, G.E.; El-Garhy, G.M.; Azzaz, H.H.; Abd El-Mola, A.M.; and Mousa, G.A. (2016). Fungal cellulose production optimization and its utilization in goat's rations degradation. Asian Journal of Animal and Veterinary Advances, 11, 824-831.

Abou-Seri, H.S.; El-Shora, M.A.; and El-Hamady, W.A. (2020). Effect of Yeast Culture and/or Fibrolytic Enzymes Supplementation on Productive and Reproductive Performances of Dairy Egyptian Buffaloes. Journal of Animal and Poultry Production. 11(12), 613-621.

Ahmed, M.A.; El-Tarabany, M.S.; and Atta, M.A. (2015). Influence of Dietary Yeast Supplementation on Growth Performance and Carcass Characteristics of Growing Lambs. Small Ruminant Research. 123(1), 1-5.

Al Ibrahim, R.M.; Baldwin, R.L. V.I.; and McLeod, K.R. (2010). Effects of Yeast Culture on Ruminal Fermentation and Performance of Lactating Dairy Cows. Journal of Dairy Science. 93(10), 4854-4864.

Azzaz, H.H.; Kholif, A.M.; Murad, H.A.; Hanfy, M.A.; and Abdel Gawad, M.H. (2012). Utilization of cellulolytic EFEs to improve the nutritive value of banana wastes and performance of lactating goats. Asian Journal of Animal and Veterinary Advances. 7, 664-673.

Azzaz, H.H.; Farahat, E.S.A.; and Ebeid, H.M. (2017). Effect of partial replacement of corn grains by date seeds on rahmani ram's nutrients digestibility and Nubian goat's milk production. Int. J. Dairy Sci. 12: 266-274.

Azzaz, H.H.; Morsy, T.A.; and Murad, H.A. (2016). Microbial feed supplements for ruminant's performance enhancement. Asian Journal of Agricultural Research, 10, 1-14.

Bhasker, T.V.; Nagalakshmi, D.; and Srinivasa Rao, D. (2013). Development of appropriate fibrolytic enzyme combination for maize stover and its effect on rumen fermentation in sheep. Asian Australasian Journal of Animal Science. 26: 945-951.

Can, M.Y.; Wang, L.; Meng, Q.X.; Ren, L.P.; and Zhou, Z.M. (2007). Effect of yeast culture or cellulolytic enzymes in licking blocks on rumen fermentation and fibre degradation in vitro. Journal of Animal and Feed Sciences. 16, 494-499.

Chaucheyras-Durand, F.; Walker, N.D.; and Bach, A. (2008). Effects of active dry yeasts on the rumen microbial ecosystem: Past, present and future. Animal Feed Science and Technology, 145, 5- 26.

Duncan, D.B., (1955). Multiple range and multiple F tests. Biometrics, 11, 1-42.

Elghandour, M.M.Y.; Kholif, A.E.; Marquez-Molina, O.; Vazquez-Armijo, J.F.; Puniya, A.K.; and Salem, A.Z.M. (2015[a]). Influence of individual or mixed cellulase and xylanase mixture on *in vitro* rumen gas production kinetics of total mixed rations with different maize silage and concentrate ratios. Turkish Journal of Veterinary & Animal Sciences, 39, 435-442.

Elghandour, M.M.Y.; Salem, A.Z.M.; Castañeda, J.S.M.; Camacho, L.M.; Kholif, A.E.; and Chagoyán, J.C.V. (2015[b]). Direct-fed microbes: A tool for improving the utilization of low quality roughages in ruminants. Journal of Integrative Agriculture, 14, 526-533.

Erasmus, L.J.; Robinson, P.H.; Ahmadi A.; Hinders R.; and Garrett J.E. (2005). Influence of prepartum and postpartum supplementation of a yeast culture and monensin, or both, on ruminal fermentation and performance of multiparous dairy cows. Animal feed Science and Technology, 122: 219-239.

Eun, J.-S.; Beauchemin, K.A.; and Schulze, H. (2007). Use of an *in vitro* fermentation bioassay to evaluate improvements in degradation of alfalfa hay. Animal Feed Science and Technology, 35, 315–328.

Fadel, M.; and El-Ghonemy, D.H. (2015). Biological fungal treatment of olive cake for better utilization in ruminants nutrition in Egypt. International Journal of Recycling of Organic Waste in Agriculture, 4, 261-271.

Fayed, A.M.; El-Ashry, M.A.; and Aziz, H.A. (2009). Effect of feeding olive tree pruning by-products on sheep performance in Sinai. World Journal of Agricultural Sciences, 5, 436-445.

Flatt, W.P.; Warner, R.G.; and Loosli, J.K. (1956). Absorption of volatile fatty acids from the reticulo-rumen of young dairy calves. Journal of Dairy Science, 39, 928.

Froetschel, M.A. (1990). Effects of Supplemental Fat on

Ruminal Fermentation in Continuous Culture Fermenters and on Site and Extent of Digestion in Steers. Journal of Animal Science. 68(11), 3687-3699.

Gaafar, H.M.A.; Mohi El-Din, A.M.A.; Basiuoni, M.I.; and El-Menawy, N.M.A. (2010). Effect of fibrolytic enzyme supplementation and live yeast culture on performance of lactating buffaloes. Journal of Animal and Poultry Production, 1(2), 53-63.

Ganai, A.M.; Sharma, T.; and Dhuria, R.K. (2011). Influence of exogenous fibrolytic enzymes on *in vitro* fermentation of bajra straw in goats. Veterinary Practitioner. 12, 138-141.

Ganai, A.M.; Mattoo, F.A.; and Ganai, T.A. (2015). Effect of Exogenous Fibrolytic Enzymes on Nutrient Utilization and Growth Performance in Lambs. Small Ruminant Research, 123(1), 182-186.

Garg, D.D.; Sharma, T.; and Dhuria, R.K. (2009). Evaluation of groundnut straw based complete feed blocks alone and in combination with yeast in ration of sheep. Animal Science and Feed Technology, 9,137-144.

Go´mez Cabrera, A.; Parellada, J.; Garrido, A.; and Ocana, F. (1982). Olive leaves utilisation in animal feeding. ii, Nutritive value. Avances en alimentación y mejora animal, 23, 75–77.

Gurpreet Singh; Kulkarni, S.; and Singh, R. (2008). Effect of *Saccharomyces cerevisiae* (Yea-sacc1026) supplementation on rumen profile in buffaloes. Indian Journal of Animal Sciences. 78, 172-174.

Harper, K.; and McNeill, D. (2015). The Role iNDF in the Regulation of Feed Intake and the Importance of Its Assessment in Subtropical Ruminant Systems (the Role of iNDF in the Regulation of Forage Intake). Agriculture, 5(3), 778–790. doi:10.3390/agriculture5030778.

Harrison, G.A.; Hemken, R.W.; Dawson, K.A.; Harmon, R.J.; and Barker, K.B. (1988). Influence of addition of yeast culture supplement to diets of lactating cows on ruminal fermentation and microbial populations. Journal of Dairy Science, 71, 2967-2975.

Hassan, A.A.; Salem, A.Z.M.; Kholif, A.E.; Samir, M.; Yacout, M.H.; Hafsa, S.A.; Mendoza, G.D.; Elghandour, M.M.Y.; Ayala, M.; and Lopez, S. (2016). Performance of crossbred dairy Friesian calves fed two levels of *Saccharomyces cerevisiae*: intake, digestion, ruminal fermentation, blood parameters and faecal pathogenic bacteria. The Journal of Agricultural Science,Cambridge, 154, 1488-1498.

Hend, A.A. (2009). Effect of feeding olive tree pruning by-products in sinai on sheep performance. Ph.D. Thesis, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

Hong, P.H.; and Gallaghe, J.R. (1994). The effects of yeast supplement on digestibility of low quality roughage fed to sheep. Protocol Australia Soc. Animal Production, 20, 398.

Hristov, A.N.; McAllister, T.A.; and Cheng, K.J. (2000). Intraruminal supplementation with increasing levels of exogenous polysaccharide-degrading enzymes: effects on nutrient digestion in cattle fed a barley grain diet. Journal of Animal Science, 78, 477-487.

Ibrahim, Al. R.M.; Gath, V.P.; Campion, D.P.; Mc Carney, C.; Duffy, P.; and Mulligan, F.J. (2012). The effect of abrupt or gradual introduction to pasture after calving and supplementation with *Saccharomyces cerevisiae* (Strain 1026) on ruminal pH and fermentation in early lactation dairy cows. Animal Feed Science Technology. 178, 40-47.

Khattab, H.M.; Gado, H.M.; Kholif, A.E.; Mansour, A.M.; and Kholif, A.M. (2011). The potential of feeding goats sun dried rumen contents with or without bacterial inoculums as replacement for berseem clover and the effects on milk production and animal health. International Journal of Dairy Science, 6, 267-277.

Kholif, A.E.; Kassab, A.Y.; Azzaz, H.H.; Matloup, O.H.; Hamdon, H.A.; Olafadehan, O.A.; and Morsy, T.A. (2018). Essential oils blend with a newly developed EFE cocktail works synergistically to enhance feed utilization and milk production of Farafra ewes in the subtropics. Small Ruminant Research, 161, 43-50.

Lara Bueno, A.; Mendoza Martínez, G.D.; Hernández García, P.A.; Martínez García, J.A.; and Plata Pérez, F.X. (2013). Evaluation of high doses of exogenous fibrolytic enzymes in lambs fed an oat straw based ration. Animal Nutrition and Feed Technology, 13, 355-362.

Lee, O.H.; Lee, H.B.; Lee, J.; Son, J.Y.; and Rhee, S.K. (2005). Chemical properties of olive and bay leaves. Journal of the Korean Society of Food Science and Nutrition, 34, 503-508.

Linn, J.G. (1988). Factors affecting the composition of milk from dairy cows. Designing Foods: Animal Product Options in the Marketplace. National Research Council (US) Committee on Technological Options to Improve the Nutritional Attributes of Animal Products, ed. Natl. Acad. Press, Washington, DC, pp.224.

Lopuszanska-Rusek, M.; and Bilik, K. (2011). Fibrolytic enzymes and live yeast cultures in rations for dairy cows- effect on rumen degradability and fermentation. Annals of Animal Science, 11, 393- 403.

Mahender, M.; Prasad V.L.K.; and Reddy G.V.N. (2006). Effect of yeast culture on growth and nutrient utilization in Nellore lambs. Indian Journal of Animal Nutrition, 23, 10-13.

Ministry of Agriculture and Land Reclamation, (2024). Economic affairs, sector of agricultural statistics, Egypt.Ministry of Agriculture, Egypt.

Morsy, T.A.; Kholif, A.E.; Kholif, S.M.; Kholif, A.M.; Sun, X.; and Salem, A.Z.M. (2016). Effects of two enzyme feed additives on digestion and milk production in lactating Egyptian buffaloes. Annals of Animal Science, 16, 209-222.

Nehra, R.; Sharma, T.; Dhuria, R.K.; and Dangi, S.S. (2014). Effect of feeding green gram straw-based com-

plete feed blocks with or without live yeast (*Saccharomyces cerevisiae*) supplementation in ration of goats. Animal Nutrition and Feed Technology, 14, 321-328.

Newbold, C.J.; Wallace, R.J.; and McIntosh, F.M. (1996). Mode of action of the yeast *Saccharomyces cerevisiae* as a feed additive for ruminants. British Journal of Nutrition, 76, 249-261.

NRC, (2007). Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids, and New World Camelids. National Academy Press, Washington, DC, USA.

Pinos-Rodriguez, J.M.; Moreno, R.; Gonzalez, S.S.; Robinson, P.H.; Mendoza, G.; and Alvarez, G. (2008). Effects of exogenous fibrolytic enzymes on ruminal fermentation and digestibility of total mixed rations fed to lambs. Animal Feed Science and Technology, 142, 210-219.

Poonooru, R.K.R.; Kumar, D.S.; Rao, E.R.; and Rao, K.A. (2015). Rumen fermentation pattern in Buffalo Bulls Fed Total Mixed Rations Supplemented with Exogenous Fibrolytic Enzymes and / or Live Yeast Culture. Journal of Advanced Veterinary and Animal Research, 2(3), 310-315.

Raj Kiran, R.; and Srinivas Kumar, D. (2013). Influence of yeast culture supplementation on rumen fermentation of bulls fed complete rations. International Journal of Agricultural Science and Veterinary Medicine, 1, 8-15.

Rojo, R.; Kholif, A.E.; Salem, A.Z.M.; Elghandour, M.M.Y.; Odongo, N.E.; de Oca, R.M.; Rivero, N.; and Alonso, M.U. (2015). Influence of cellulase addition to dairy goat diets on digestion and fermentation, milk production and fatty acid content. The Journal of Agricultural Science, Cambridge, 153, 1514-1523.

Rojo, R.; Mendoza, G.D.; González, S.S.; and Bárcena, R. (2009). Effect of Exogenous Fibrolytic Enzymes on In Vitro and In Vivo Degradation of Forages for Ruminants. Animal Feed Science and Technology, 149(1-2), 70-77.

Roth, H. P.; Schulein, A.; and Kirchgessner, M. (1992). Influence of alimentary zinc deficiency on digestibility of nutrients and zinc utilization in force fed rats. Journal of Animal Physiology and Nutrition (Germany), 68, 136-145.

SAS., (2006). Statistical Analysis System. Version 9.4, SAS Inst., Inc., Cary, NC.

Singh, K.K.; and Das, M.M. (2009). Effect of fibrolytic enzyme treated wheat straw on rumen fermentation and nutrient utilization in calves. Indian Veterinary Journal, 86, 380-382.

Srinivas Kumar D.; Rama Prasad J.; Raghava Rao E.; and Sarjan Rao K. (2011). Rumen fermentation pattern in graded Murrah buffalo bulls fed on Levucell SC 20 yeast (*Saccharomyces cerevisiae*) culture. Animal Science Reporter, 5, 43-49.

Titi, H.; Dmour, R.H.; and Abdullah, A.Y. (2008). Growth performance and carcass characteristics of Awassi lambs and Shami goat kid culture in their finishing diet. Journal of Animal Science, 142,375-383.

Togtokhbayar, N.; Cerrillo, M.A.; Rodríguez, G.B.; Elghandour, M.M.Y; Salem, A.Z.M.; Urankhaich, C.; Jigjidpurev, S.; Odongo, N.E.; and Kholif, A.E. (2015). Effect of exogenous xylanase on rumen *in vitro* gas production and degradability of wheat straw. Animal Science Journal, 86, 765-771.

Torres, N.; Mendoza, G.D.; Bárcena, R.; Loera, O.; González, S.; Aranda, E.; Hernández, P.A.; and Crosby, M. (2013). Effects of Various Fibrolytic Enzyme Extracts on Digestibility and Productive Performance of Lambs Fed a Forage-Based Diet. Animal Nutrition and Feed Technology, 13, 381-389.

Van Soest, P.J. (1982). Nutritional Ecology of the Ruminant. O&B Books, Inc., Corvallis, Oregon.

Van Soest, P. J., Robertson, J. B.; and Lewis, B. A., (1991). Methods of dietary fibre, neutral detergent fibre, and non starch polysaccharide in relation to animal nutrition. Journal of Dairy Science, 74, 3583-3597

Wang, Y.; McAllister, T.A.; Rode, L.M.; Beauchemin, K.A.; Morgavi, D.P.; Nsereko, V.L.; Iwaasa, A.D.; and Yang, W. (2001). Effects of an exogenous enzyme preparation on microbial protein synthesis, enzyme activity and attachment to feed in the Rumen Simulation Technique (Rusitec). British Journal of Nutrition, 85, 325-332.

Yang, W.Z.; Beauchemin, K.A.; and Rode, L.M. (1999). Effects of an enzyme feed additive on extent of digestion and milk production of lactating dairy cows. Journal of Dairy Science, 82, 391-403.