Egypt. J. Chem. **Vol. 65**, No. 5 pp. 271 - 278 (2022)

Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Chemical Changes in Digestibility, Blood and Milk Composition of Barki Ewes Fed Olive Tree By-products Treated with Urea or *Phanerochaete chrysosporium*

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Abstract

Olive tree by-products (OTB) were examined to be used as an alternative feed for ruminants after improving their chemical composition through urea and *Phanerochaete chrysosporium* treatments. Twenty eight lactating Barki ewes were randomly assigned to four groups (seven animals each) using the complete random design. Ewes were fed 70% concentrate feed mixture (CFM) + 30% Berssem hay (R_1), 70% CFM + 30% untreated OTB (R_2), 70% CFM+30% OTB treated with urea (R_3), and 70% CFM+30% OTB treated with *Phanerochaete chrysosporium* (R_4).Chemical and biological treatments were so effective in fiber decomposition of OTB and improve its nutritive value. Ruminal total volatile fatty acids, NH_3-N concentrations and microbial protein synthesis were higher in treated groups $R_3$and R_4 than R_2 group. Urea treatment was superior over biological treatment ($p<0.05$) for improvement of all nutrients digestibility, blood serum glucose, protein and albumin, milk yield and milk composition. Inclusion of chemically and biologically treated OTB in lactating ewes's rations improved their productive performance with no deleterious effects on the health.

Key words: Urea, *Phanerochaete chrysosporium*, Olive tree by products, Rumen fermentation and lactating ewes.

1. Introduction

The steady increase of the population in Egypt and increased consumer's awareness of healthy diets, led to more demand for meat, milk and their products. The supply of meat and milk in the market does not cover the increasing demand for them, which led to a food gap and a continuous increase in the prices of meat and milk [1]. On the other hand, there is an acute shortage in conventional feedstuffs led to a continuous increase in feeds prices year by year [2]. Therefore, researchers and animal nutritionists are working on developing strategies aimed to increase animal's productivity and improving their health in an economical manner [3]. The most prominent of these strategies lies in the use of feed additives and the development of alternative feedstuffs that do not compete with humans in their food sources [4]. Many of feed additives and supplements such as feed enzymes (cellulase, xylanase , phytase, tannase and Pectinase)[5-7], beneficial bacteria and yeasts [8], medicinal and aromatic plants and their essential oils [9], algae and mineral elements [10] were used to improve animal's health and productivity. These additives manipulate and make desirable changes in the rumen fermentation by production of more volatile fatty acids (the main source of energy) and microbial protein with reducing methane and carbon dioxide production [11].

Concerning with development of feed resources, there are serious attempts to improve the nutritional value of the agricultural residues by conducting some physical, chemical and biological treatments to be used as alternative feedstuffs [12]. Despite large areas are cultivated by olive trees in Egypt, there are a great amount of olive by products without beneficial usage and are considered as wastes. It has been estimated that each olive tree could produce 22 kg leaves and twigs per year and 25 kg olive cake per 100 kg olive fruits [13]. Lack of use of such agricultural wastes in animal feeding is due to their high content of lignocellulosic fibers and low protein content [14]. Chopping the agricultural residues and treating them chemically with urea or biologically by fiber degrading microbes are the most common treatments in Egypt [15].The basic principle of agricultural wastes treatment with urea is to weaken the lignified cell wall and enrich it with

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Receive Date: 02 October 2021, Revise Date: 18 October 2021, Accept Date: 31 October 2021
DOI: 10.21608/ejchem.2021.99132.4610

nitrogen source which allowing for more effective fermentation and liberation of nutrients [16]. Biological treatments could be achieved using various microorganisms adopting the solid substrate fermentation and can degrade cellulose and lignin in the cell wall of the agricultural wastes [17]. White rot fungi (ex: *Phanerochaete chrysosporium*) can degrade high lignin agricultural wastes as it known to produce lignin peroxidase (LiP), manganese peroxidase (MnP) and laccase enzymes [18].

The response of agricultural residues to decomposition by urea or fungi treatments varies according to the type of agricultural waste, the concentration of urea, fungi type, media chemical composition and fermentation conditions [19].

The current study aimed to investigate the impact of olive tree by-products (OTB) treated with urea and *Phanerochaete chrysosporium* on nutrients digestibility, blood parameters and milk yield and composition of Barki lactating ewes.

Experimental:

Urea and *Phanerochaete chrysosporium* treatments for olive tree by-products

The olive tree by-products (OTB) were collected from olive farms along Cairo - Alexandria Saharan Road, then chopped and dried naturally for two weeks and packed till use. For urea treatment, the air-dried OTB was moistened for 40 % before being sprayed with urea solution (4% on DM basis). After that, 10% of molasses solution on DM base was added as an energy source in ensiled mixture. Finally, the mixture was kept in tightly closed plastic bag for 21 days until opened and air dried for further chemical analysis. For biological treatment, *Phanerochaete chrysosporium* was obtained from the Microbial Genetic Department, National Research Centre, Dokki, Cairo, Egypt. *P. chrysosporium* was maintained on agar medium composed of (g/L) yeast extract, 3.0; malt extract, 30; peptone, 5.0; sucrose 20 and agar 20. Spore suspension of microorganisms was prepared and used to inculcate (10 % V/V) a sterilized liquid medium containing (g/L) 4% molasses, 0.4% urea, 0.2% KH_2 PO_4 and 0.03 Mg $SO_4.7H_2O$ and incubated for 7 days. After the incubation period, *Phanerochaete chrysosporium* culture was added to olive tree by-products (2.5 Litre/ ton), then put on plastic sheets and incubated in a room at 25-30 ºC for 21 days. The moisture was kept at 60% by moistened the bulk with 10 % molasses solution using a sprayer' tank with complete and continuous stirring every 2 days. After 21 day, the fermented OTB was air dried to 6-8% moisture then packed until feeding.

Ewes feeding and experimental design

Twenty eight lactating Barki ewes (about 2 years old and weighing on average 33.5 ± 0.75 kg) after 7 days of parturition were randomly assigned to four groups of seven animals each using the complete random design. The entire experimental period was 63 days. Ewes were fed dry matter according to 4% of their body weight twice daily at 8.00am and 4pm, water was offered freely. Ewes first group (R_1) was fed ration consisted of 70% concentrate feed mixture (CFM: 60% corn, 22% soybean meal , 15% wheat bran,1% limestone,1% minerals and vitamins mixture and1% NaCl) +30% Berseem hay. The second group(R_2) was fed ration (70% CFM + 30% untreated olive tree by-products (OTB). The third group (R_3) was fed ration (70 % CFM + 30 % olive tree by-products treated with urea (OTBU), while the fourth group (R_4) was fed ration (70 % CFM + 30 % olive tree by-products treated with *Phanerochaete chrysosporium* (OTBP).

Apparent digestibility

A grab sample method was applied at which acid insoluble ash was used as an internal marker for determination of nutrient digestion coefficients. During the last seven days of each month of the experimental period, fecal grab samples were collected from four animals of each group in cloth bag connected to the animal back after 4h of morning feeding. The collected faeces were dried in an oven at 60 ºC for 48 hrs. The dried faeces from each animal were ground for chemical analysis. The digestibility coefficient of nutrient was calculated according to Ferret et al, [20] formula as follows:

Digestion co-efficient =

$$100 - \left[100x \frac{\%indicator\ in\ feed}{\%indicator\ in\ feces} x \frac{\%nutrient\ in\ feces}{\%nutrient\ in\ feed} \right]$$

Feed and fecal analysis

Feedstuffs and fecal samples were analyzed according to the methods of A.O.A.C., [21] to determine crude protein (CP), ether extract (EE), crude fiber (CF) and ash contents. The neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin contents were determined using the methods described by Van Soest et al, [22].

Sampling and analysis of rumen liquor

Rumen liquor samples were collected at 12 pm by stomach tube from two animals in each group at the last 3 days of each month of the experimental period. Ruminal pH was determined using digital pH-meter. Ammonia nitrogen concentration (NH3-N) was determined by the modified semi-micro-kjeldahl digestion method according to A.O.A.C., [21].The total volatile fatty acids (TVFA's) were determined according to the method of Warner [23]. The ruminal microbial protein was estimated as described by Makkar et al, [24].

Sampling and analysis of blood serum

Blood samples were taken from jugular vein of four animals each group through the last 3 days of each month of the experimental period. At about 4 h after morning feeding the blood samples were collected in glass tubes and left to coagulate at room temperature. Serum was separated by centrifugation at 4000 Xg /20 min. and kept frozen at -20ºc for later analysis of glucose, total protein, albumin, urea, aspartate aminotransferase (AST) and alanin aminotransferase (ALT) according to kits manufactured brochure procedures.

Sampling and analysis of milk

The ewes were milked twice a day at 8.00 a.m. and 4.00 p.m. during the last 3 days of each month of the experimental period. Milk samples were immediately collected from each animal after morning and evening milking and milk yield was recorded. Milk samples were analysed for the total solids, fat, protein and lactose by Bentley150 infrared milk analyzer (Bentley Instruments, Chaska, MN, USA). Solids-not-fat (SNF) was calculated by subtracting fat from total solids percentage. Fat corrected milk (4% fat) was calculated by using Gaines [25] equation:

FCM = 0.4 M + 15 F, Where: M= milk yield (g) and F= fat yield (g).

Statistical analysis

Data obtained from this study were statistically analysed by IBM SPSS Statistics for Windows [26] using the following general model procedure:

$$Y_{ij} = \mu + T_i + e_{ij}.$$

Where Y_{ij} is the parameter under analysis of the ij ewes of digestibility and lactation trails, μ is the overall mean, T_i is the effect due to treatment on the parameter under analysis, eij is the experimental error for ij on the observation, the Duncan's multiple range test [27] was used to test the significance among means.

Results and discussion

Chemical changes in the composition of olive trees by-products and experimental rations due to urea and *Phanerochaete chrysosporium* treatments: Data of Table (1) shows the chemical composition of the tested feed ingredients with special focusing on chemical changes in the composition of olive tree by-products (OTB) due to treatments with urea or white-rot fungi (*Phanerochaete chrysosporium*). There are no marked changes in the DM, OM, EE, NFE and ash content of the treated OTB with urea (OTBU) and *P. chrysosporium* (OTBP) when compared with untreated OTB. While the CP, CF, NDF, ADF, ADL, cellulose and hemicellulose contents of OTB were changed markedly due to chemical or biological treatments. It's obvious that treatment olive tree by-products with urea or *P. chrysosporium* enrich its content with crude protein by 85.71% and 56.20% respectively, but decreased its content of crude fiber by 24.37% and 19.28% respectively. The higher protein content of the urea treated OTB than those of untreated OTB is may be due to the conversion of urea to ammonia in the bulk of the treated OTB. This chemical reaction let for more OTB's fiber degradation especially lignin and enrich OTB with non-protein nitrogen. The addition of basal mineral media containing nitrogen salts and release of water-soluble sugar from OTB's polysaccharides might have led to faster growth of *P. chrysosporium* which in turn resulted in higher CP content. The high ability of *P. chrysosporium* for production of fiber degrading enzymes such as lignin peroxidase may be the reason for OTB's fiber content reduction [18]. The obtained data is consistent with those obtained by Aboamer et al, [16], who observed an increase in crude protein (CP) content of urea treated OTB with a reduction of its content of fiber and fiber fractions. Also Darwish,[28] noted an increase in CP content of wheat straw from 2.20% to 7.40% with a significant reduction of CF content after treated it with 10% (liter/weight) of *Phanerochaete chrysosporium.*

Data of Table (2) shows the impact of inclusion of the chemically and biologically treated olive tree by-products in ewe's experimental rations. Inclusion of urea treated olive tree by-products in ewe's rations increased its content of crude protein with a reduction of its content of CF than those of untreated or treated OTB with *P. chrysosporium*. This may be due to the superior of urea over *P. chrysosporium* for improvement of nutritional value of olive tree by-products (Table 1). The chemical composition of the ration contains urea treated olive tree by-products (R_3) is so close to the chemical composition of the standard ration which contains berseem hay (R_1). The ration (R_2) which contains the untreated olive tree by-products showed the lowest protein content with the highest crude fiber content, this reflecting the importance of the chemical and biological treatments for such agricultural residue. The current findings are supported by the findings of Aboamer et al, [16] who found that urea treatment for olive tree by products improved the nutritional value especially protein content of the whole experimental ration. Also Azzaz et al, [29] noted an improvement in the nutritional value of ewe's ration due to feeding olive tree by-products treated with fungi

(*Trichoderma viride* or yeasts) than those of control ration.

Ewe's feed intake and nutrients digestibility as affected by urea and *Phanerochaete chrysosporium* treatments: Data of dry matter intake for ewes fed the experimental rations are presented in Table (3). Ewes fed urea treated olive tree by-products (R_3) had the highest fed intake (g/h/d), followed by ewes fed berseem hay (R_1) with no significant difference, than ewes fed *P. chrysosporium* treated olive tree by-products (R_4).While, ewes fed untreated olive tree by-products (R_2) had the lowest feed intake. This could be attributed to the higher NDF, ADF and ADL contents which may negatively affect the feed consumption (Table 2). The improvement of feed intake with urea and *P. chrysosporium* treatments might be due to improved N-status of animals, increase rate of breakdown of the feed particles in the rumen with increased their passage rate to small intestine [30]. Similar results were reported by Aboamer et al, [16] who found that ewes fed urea treated olive tree by-products showed a higher feed intake than those fed untreated olive tree residue. Also, Azzaz et al, [29] observed higher feed intake for ewes fed biologically (*T. viride or S. cerevisiae*) treated olive tree by-products than those fed untreated olive tree by-products. The ewes fed (R_3) ration which contain urea treated OTB has the highest values for all nutrients and fibre fraction digestibility coefficients (Table 3). While ewes fed (R2) ration which contains the untreated OTB showed the lowest digestibility coefficients for all nutrients and fibre fractions. There were no significant differences between ewes fed R_1 and R_4 for digestibility coefficients for all nutrients and fibre fractions. Relatively low digestibility of nutrients in R_2 ration could be explained by their high contents of cell wall constituents as reported by Aziz, [30].

The improvement of all nutrients digestibility might be due to the better palatability of treated rations than untreated ones. The improvement of nutrients digestibility in particular CP and CF recorded for urea treatment does not appear to be only due to satisfy the requirements of nitrogen for rumen microbes which may have been at least partially or completely met, but possibility to an additional effect of ammonia (released from urea hydrolysis in the silo) on OTB cell wall or changes that may have occurred in the lignocellulosic fibers [31]. Similar results were reported by Aboamer et al, [16] who returned the increased digestibility of urea treated OTB ration to the absorption of a comparatively higher amount of ammonia through the rumen wall which, in turn stimulated microbial protein synthesis and hence, increased CF digestibility. Concerning the positive impact of biological treatment on nutrient digestibility for R_4 ration, it's well known that white rot fungi exhibited promising properties for the decomposition of lignin-cellulose containing materials and for increasing the availability of carbohydrates and production of fungal protein [30]. In consistent with the current results, Azzaz et al, [29] stated that biological treatment for olive tree by-products with *T. viride* or *S. cerevisiae* improves digestibility of most nutrients.

Chemical changes in rumen liquor parameters as affected by ration's treatments: Ruminal parameters results of ewes fed the different experimental rations are illustrated in Table (4). Ruminal pH values were significantly affected by the treatments. The ewes fed urea treated OTB (R_3) recorded the lowest pH values, while ewes fed untreated OTB (R_2) recorded the highest pH values. There were no significant differences between ewes fed berseem hay (R_1) and biologically treated OTB (R_4) in values of ruminal pH. In contrast, the total volatile fatty acids (TVFA's), ammonia nitrogen (NH3-N) and microbial protein concentrations recorded the highest values for ewes fed urea treated OTB (R_3), while ewes fed untreated OTB (R_2) recorded the lowest ruminal TVFA's, NH3-N and microbial protein concentrations. No significant differences were detected between ewes groups R_1 and R_4 in concentrations of ruminal TVFA's, NH3-N and microbial protein.

The current results are in agreement with that found by Aboamer et al, [16] who stated that ruminal pH was inversely related to the concentration of TVFA's produced in the rumen. The noticeable increase ($p<0.05$) in the TVFAs, NH3-N, and microbial protein concentration with decreasing ruminal pH in ewes fed urea treated OTB is may be due to the positive role of urea treatment in the decomposition of CF and enrichment of the OTB with an additional nitrogen source. Also, the biological treatment for the OTB by *P. chrysosporium* improves its nutritive value to be comparable to the berseem hay (Table 1) and this may be the reason for the lack of changes in the ruminal parameters of $R_1$and R_4 ewes groups. These results of the biological treatments might be related to the more utilization of the dietary energy and positive fermentation in the rumen due to alteration of rumen microbial populations and increase of microbial activity. Similarly, Aboamer et al, [16] found that ewes fed urea treated olive tree residues showed higher concentrations of TVFA's, NH3-N and microbial protein synthesis than those fed untreated olive tree by- products and Berseem hay. The same results were reported by Azzaz et al, [29] who found that ewes fed treated OTB with *Trichoderma viride* or yeast improved all ruminal parameters than those fed untreated OTB.

Chemical changes in blood parameters as affected by ration's treatments: Results of Table (5) illustrate the chemical changes in blood parameters of ewes fed urea or P. *chrysosporium* treated olive tree by-products. Ewes fed urea treated OTB (R_3) recorded the highest glucose, total serum proteins, albumin and serum urea concentrations, while ewes fed untreated OTB (R_2) showed the lowest values for all blood tested parameters. There were no significant differences in all blood parameter between ewes fed Berseem hay (R_1) and ewes fed *P. chrysosporium* treated OTB (R_4). Also, no change was detected between all ewes groups in blood serum globulin, alanin aminotransferase (ALT) and aspartate aminotransferase (AST) values. The present values for all blood parameters are within the normal ranges and in agreement with those obtained by Aboamer et al, [16] and Azzaz et al, [29]. Increasing glucose, urea, protein and albumin concentrations in blood of ewes fed urea and *P. chrysosporium* treated OTB than those fed untreated OTB could be explained by efficient CF, NFE, NDF and ADF digestibility, sufficient synthesis of microbial protein in the rumen and more absorption of protein in the small intestine. These results were parallel with values of CP content of the feed ingredients and the results of organic matter and crude protein digestibility which indicated better utilization of dietary protein through the digestive tract (Tables 1,3). These results are in line with those obtained by Aziz, [30] who concluded that tested animals were not in a catabolism situation and kidney function was not affected by ewes feeding OTB treated with urea and/or fungi. It is known that globulin is formed by lymphatic tissue and the aminotransferases (AST and ALT) act as catalytic agents for connecting the metabolism of amino-acids and carbohydrates. Lack of significant changes in globulin, AST and ALT for all experimental ewes groups means that no harmful impacts of the treatments on the liver functions or animal's immunity.

Changes in milk yield and milk composition as affected by ration's treatments: Results of Table (6) illustrate the changes in milk yield and milk composition of ewes fed urea or *P. chrysosporium* treated olive tree by-products. Ewes fed urea treated OTB (R_3) recorded the highest milk yield, 4% fat corrected milk yield and all milk component percentages, while ewes fed untreated OTB (R_2) showed the lowest values for milk yield and milk components. No significant differences in milk yield and milk composition between ewes fed berseem hay (R_1) and ewes fed *P. chrysosporium* treated OTB (R_4). Also, no change was detected between all ewes groups in milk ash percentage. The improvement of milk yield and milk composition after chemical and biological treatments than untreated OTB might be due to the positive impact of urea and *P. chrysosporium* on OTB chemical composition especially fibre content, rumen fermentation and nutrient digestibility (Table 1,3 and 4). The current results are in line with those of Aboamer et al, [16] and Azzaz et al, [29] they reported that Barki ewes fed olive tree by-products treated with urea or *S. cerevisiae* and/or *T. viride* showed a significant improvement in milk yield and milk component yield when compared with ewes fed untreated olive tree by-products.

Conclusions

The chemical (urea) and biological (*P. chrysosporium)* treatments improved the nutritive value of olive tree by-products and made it comparable to the nutritive value of berseem hay or superior over it. Urea or *P. chrysosporium* treatments made fibre content of olive tree by-products more amenable for decomposition exogenously and consequently let for more fermentation and digestion endogenously. Milk production of ewes fed urea or *P. chrysosporium* treated OTB was improved by 25% and 17.5% respectively when compared with those received the untreated OTB with no harmful impacts on animal's health.

Conflicts of interest

"There are no conflicts of interest to declare".

References

[1] Khattab M.S.A., H.H. Azzaz, Ahmed M. Abd El Tawab and Hussein A. Murad, 2019. Production optimization of fungal cellulase and its impact on ruminal degradability and fermentation of diet. Int. J. Dairy Sci., 14: 61-68.

[2] Kholif, S.M., 2006. Effect of improving the nutritional value poor quality roughages on the yield and composition of goat's milk. Egyptian J. Dairy Sci., 34:197-205.

[3] Azzaz H.H, Eman S.A. Farahat and Hossam M. Ebeid. (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.

[4] Ismail S.A, Azza M. Abdel-Fattah, Mohamed A. Emran, Hossam H. Azzaz, Mamdouh S. El-Gamal and Amal M. Hashem, (2018). Effect of partial substitution of ration's soybean meal by biologically treated feathers on rumen fermentation characteristics (*in vitro*). Pakistan Journal of Biological Sciences, 21(3): 110-118.

[5] Abd El Tawab A.M, H.A. Murad, Mostafa S.A. Khattab and H.H. Azzaz, (2019). Optimizing production of tannase and in vitro evaluation on ruminal fermentation, degradability and gas production. Int. J. Dairy Sci., 14: 53-60.

[6] Aboul-Fotouh G.E., G.M. El-Garhy, H.H. Azzaz, A.M. Abd El-Mola and G.A. Mousa. (2016). Fungal cellulase production optimization and its utilization in goat's rations degradation. Asian J. Anim. Vet. Adv., 11: 824-831.

[7] Azzaz H.H., A.A. Aboamer, Hoda Alzahar, M.M. Abdo and H.A. Murad, (2019). Effect of xylanase and phytase supplementation on goat's performance in early lactation. Pak. J. Biol. Sci., 22: 265-272.

[8] Azzaz H.H., Ebeid H.M., Morsy T.A and Kholif S.M. (2015). Impact of feeding yeast culture or yeast culture and propionibacteria169 on the productive performance of lactating buffaloes. International Journal of Dairy Science 10 (3): 107-116.

[9] Azzaz H.H., Eman S.A. Farahat, T.A. Morsy, Hend A. Aziz, Fatma I. Hadhoud and M.S. Abd-Alla. (2016). Moringa oleifera and Echinacea purpurea as supplements for Rhamani lactating ewe's diets and their effect on rumen characteristics, nutrients digestibility, blood parameters, milk production, composition and its fatty acid profile. Asian J. Anim. Vet. Adv., 11: 684-692.

[10] Kholif A.E, Hatem A Hamdon, Ayman Y Kassab, Eman SA Farahat, Hossam H Azzaz, Osama H Matloup, Ashraf G Mohamed, Uchenna Y Anele,2020. Chlorella vulgaris microalgae and/or copper supplementation enhanced feed intake, nutrient digestibility, ruminal fermentation, blood metabolites and lactational performance of Boer goat. Journal of Animal Physiology and Animal Nutrition, 104(6):1595-1605.

[11] Azzaz H.H., A.E. Kholif, A.M. Abd El Tawab, M.S.A. Khattab, H.A. Murad, O.A. Olafadehan,2020. A newly developed tannase enzyme from Aspergillus terreus versus commercial tannase in the diet of lactating Damascus goats fed diet containing pomegranate peel. Livestock Science 241, 104228.

[12] Kholif, A.M.; El-Ashry, M.A.; El-Alamy, H.A.; El-Sayed, H.M.; Fadel, M. and Kholif, S.M. (2005). Biological treatments of banana wastes for feeding lactating goats. Egyptian J. Nutrition and feeds, 8(2):149-162.

[13] Nefzaoui, A. (1995). Feeding value of Mediterranean Ruminant feed resources. Syria 12-23 March 1995. Institut National de la Recherche Agronoique de Tunisia Rue Hedi Karray 2049 Ariana, Tunisie.

[14] Abdel-Gawad, M.H., S.M. Gad, E.H. El Sabaawy, H.M. Ali and T.M. El-Bedawy, 2007. *In vitro* and *in vivo* digestability of some low quality roughages supplemented with fibrolytic enzyme for sheep. Egypt. J. Nutr. Feeds, 10: 663-677.

[15] Shoukry, M.M.; F. A. Hamissa; M. Sawsan; A. H. El- Refi; H.M. Ali and Z.M.Z. Abdel-Motagally (1985). Nutritive improvement of some low quality roughages for ruminants. 1) effect of different microbial and chemical treatments on quality of suger can bagasse. Egypt. J. Anim. Production, 25:329.

[16] Aboamer A.A., Hend A. Aziz, H. H. Azzaz, Hoda Alzahar and H.A.Murad, (2018). Impact of urea-treated olive trees by-products on Barki ewe's nutrients digestepility and milk productivity. Egyptian J. Nutrition and Feeds, 21 (3): 611-621

[17] Fayed, M. Afaf, El-Ashry M. A. and Hend A. Aziz, 2009. Effect of feeding olive tree pruning by-products on sheep performance in Sinai. Worled J. of Agric. Sci. 5: 436-445.

[18] Yanti G, N Jamarun, Elihasridas and T. Astuti (2021). Quality improvement of sugarcane top as animal feed with biodelignification by *Phanerochaete Chrysosporium* fungi on In-vitro digestibility of NDF, ADF, Cellulose and Hemicellulose. *J. Phys.: Conf. Ser.* 1940 012063

[19] Malherbe, S. and Cloete, T.E. (2003). Lignocellulose biodegradation: Fundamentals and applications. Environmental Science & Bio/Technology 1**:** 105–114

[20] Ferret, A., J. Plaixats, G. Caja, J. Gasa, P. Prió, 1999. Using markers to estimate apparent dry matter digestibility, faecal output and dry matter intake in dairy ewes fed Italian ryegrass hay or alfalfa hay, Small Rumin. Res. 33: 145–152

[21] A.O.A.C., 1995. Official Methods of Analysis of AOAC International. 16th Edn. Vol. 1, "Agricultural, Chemicals, Contaminants, Drugs". Washington, D.C., USA.

[22] Van Soest, P.J., J.B. Robertson, B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and non-starch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583–3597.

[23] Warner, A. C. J. 1964. Production of volatile fatty acids in the rumen: Methods of Measurements. Nutr. Abst. Rev., 34:339

[24] Makkar H.P.S., Sharma O.P., Dawra R.K., Negi S.S., 1982. Simple Determination of Microbial Protein in Rumen Liquor. J. Dairy Sci., 65:2170-2173.

[25] Gaines, W. L. (1928). The energy basis of measuring energy milk in dairy cows. Univ. Illinois Agric.

[26] IBM Corp. Released (2011). IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.

[27] Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics. 11:1

[28] Darwish, G.A.A. (2001). Biological treatments for nutritional upgrading of some agricultural crop residues. Thesis for ph.D. Thesis, Faculty of Agriculture. Cairo University.

[29] Azzaz H.H, Hend A. Aziz, Hoda Alzahar and H.A. Murad, (2018). Yeast and *Trichoderma viride* don't synergistically work to improve olive trees by products digestibility and lactating Barki ewe's productivity. Journal of Biological Sciences, 18 (6): 270-279.

[30] Hend.A.Aziz, (2009).Effect of feeding olive tree pruning by-products in Sinai on sheep performance. Ph.D. Thesis, Fac. Agric., Ain Shams Univ., Egypt, 200 p.

[31] Horton, G.M.J. and H.H. Nicholson, (1981). Nitrogen sources for growing cattle fed barley and either wheat straw or dehydrated alfalfa. J.Anim. Sci., 52(5) 1143-1149.

Table (1): Chemical composition of the tested feed ingredients (on DM basis)

Item	Feed ingredients				
	CFM	BH	OTB	OTBU	OTBP
DM	93.59	91.24	93.95	92.92	94.22
OM	95.02	89.72	85.75	85.43	85.05
CP	14.02	13.25	7.49	13.91	11.70
EE	3.10	3.24	4.33	4.35	4.34
CF	8.96	34.21	35.36	26.74	28.54
NFE	68.94	39.02	38.57	40.43	40.46
Ash	4.98	10.28	14.25	14.57	14.95
NDF	32.28	62.68	74.25	63.45	67.97
ADF	18.24	44.25	47.28	39.87	43.68
ADL	1.62	5.16	10.98	7.70	9.19
CEL	16.62	39.09	36.30	32.17	34.49
HCE	14.04	18.43	26.97	23.58	24.29

DM: Dry mater, OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ADL: Acid detergent lignin, CEL: Cellulose, HCE: Hemicellulose, CFM: Concentrate feed mixture, BH: Berseem hay, OTB: Olive tree by-products, OTBU: Olive tree by-products treated with urea, and OTBP: Olive tree by-products treated with *P. chrysosporium.*

Table (2): Chemical composition of the experimental rations (on DM basis)

Item	Experimental Rations			
	R1	R2	R3	R4
DM	92.89	93.70	93.39	93.78
OM	93.43	92.24	92.14	92.03
CP	13.79	12.06	13.99	13.32
EE	3.14	3.47	3.48	3.47
CF	16.54	16.88	14.29	14.83
NFE	59.96	59.83	60.39	60.40
Ash	6.57	7.76	7.86	7.97
NDF	41.40	44.87	41.63	42.99
ADF	26.04	26.95	24.73	25.87
ADL	2.68	4.43	3.44	3.89
CEL	23.36	22.52	21.29	21.98
HCE	15.36	17.92	16.90	17.12

DM: Dry mater, OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ADL: Acid detergent lignin CEL: Cellulose, HCE: Hemicellulose.

R (1): 70 % CFM + 30 % Berseem hay

R (2): 70 % CFM + 30 % olive tree by-products (OTB)

R (3): 70 % CFM + 30 % olive tree by-products treated with urea.

R (4): 70 % CFM + 30 % olive tree by-products treated with *P. chrysosporium.*

Table (3): Feed intake and nutrients digestibility of ewes fed the experimental rations

Item	Experimental groups				
	R1	R2	R3	R4	±SE
Live body weight (Kg/h)	33.71	32.3	34.25	33.8	0.27
Feed intake (g/h/d)	1496^{a}	1460^{c}	1499^{a}	1481^{b}	3.49
Digestibility%:					
DM	78.72^{b}	73.04^{c}	80.81^{a}	77.59^{b}	0.38
OM	79.77^{ab}	73.97^{c}	81.79^{a}	78.1^{b}	0.29
EE	81.88^{b}	81.34^{b}	84.29^{a}	81.66^{b}	0.45
CP	79.30^{b}	75.23^{c}	82.14^{a}	79.68^{b}	0.98
CF	72.15^{b}	68.10^{c}	77.91^{a}	72.86^{b}	0.53
NFE	82.71^{c}	81.41^{d}	86.06^{a}	83.52^{bc}	0.34
NDF	75.56^{b}	70.41^{c}	78.43^{a}	75.89^{b}	0.59
ADF	67.49^{b}	61.03^{c}	74.07^{a}	69.88^{b}	0.49
CEL	71.94^{b}	68.55^{c}	77.29^{a}	73.18^{b}	0.38
HCE	79.73^{b}	75.72^{c}	85.74^{a}	80.16^{b}	0.59

Means with different letter in the same row are significantly different at ($p<0.05$).

DM: Dry mater, OM: Organic matter, CP: Crude protein, EE: Ether extract, CF: Crude fiber, NFE: Nitrogen free extract, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, ADL: Acid detergent lignin, CEL: Cellulose, HCE: Hemicellulose

R (1): Ewes fed 70 % CFM + 30 % Berseem hay

R (2): Ewes fed 70 % CFM + 30 % olive tree by-products

R (3): Ewes fed 70 % CFM + 30 % olive tree by-products treated with urea.

R (4): Ewes fed 70 % CFM + 30 % olive tree by-products treated with *P. chrysosporium.*.

Table (4): Rumen liquor parameters of ewes fed the experimental rations.

Items	Experimental groups				±SE
	R1	R2	R3	R4	
pH	6.33[b]	6.61[a]	6.16[c]	6.28[b]	0.04
TVFA's	8.94[b]	7.72[c]	11.16[a]	9.75[b]	0.35
NH3-N	34.62[b]	30.08[c]	41.97[a]	36.26[b]	0.47
Microbial protein	107.1[b]	100.8[c]	118.9[a]	111.3[b]	2.23

Means with different letter in the same row are significantly different at ($p<0.05$).
R (1): Ewes fed 70 % CFM + 30 % Berseem hay
R (2): Ewes fed 70 % CFM + 30 % olive tree by-products
R (3): Ewes fed 70 % CFM + 30 % olive tree by-products treated with urea.
R (4): Ewes fed 70 % CFM + 30 % olive tree by-products treated with *P. chrysosporium*..
TVFA's: Total volatile fatty acids.

Table (5): Blood parameters of ewes fed the experimental rations.

Item	Experimental groups				
	R1	R2	R3	R4	±SE
Glucose (mg/dl)	70.24[b]	67.16[c]	75.76[a]	70.12[b]	1.41
Total proteins (g/dl)	6.32[b]	6.06[c]	6.93[a]	6.35[b]	0.08
Albumin (g/dl)	3.65[b]	3.25[c]	4.05[a]	3.75 [b]	0.09
Globulin (g/dl)	2.67	2.81	2.88	2.6	0.13
Urea (mg/dl)	29.83[b]	27.43[c]	36.69[a]	30.08[b]	0.70
ALT U/L	34.71	32.88	33.52	34.75	1.13
AST U/L	26.31	24.56	26.06	25.68	0.24

Means with different letter in the same row are significantly different at ($p<0.05$).
R (1): Ewes fed 70 % CFM + 30 % Berseem hay
R (2): Ewes fed 70 % CFM + 30 % olive tree by-products
R (3): Ewes fed 70 % CFM + 30 % olive tree by-products treated with urea.
R (4): Ewes fed 70 % CFM + 30 % olive tree by-products treated with *P. chrysosporium.*
AST: Aspartate aminotransferase
ALT: Alanin aminotransferase

Table (6): Milk yield and milk composition of ewes fed the experimental rations.

Items	Experimental groups				±SE
	R1	R2	R3	R4	
Milk yield ml/h/d	1100[b]	948[c]	1185[a]	1115[b]	6.81
4% FCM ml/h/d	1003[b]	857[c]	1107[a]	1018[b]	6.87
Milk composition					
Total solids	12.50[b]	12.11[c]	13.05[a]	12.59[b]	0.11
Fat	3.41[b]	3.36[c]	3.56[a]	3.42[b]	0.01
Solids not fat	9.09[b]	8.75[c]	9.49[a]	9.17[b]	0.08
Total protein	3.67[b]	3.55[c]	3.81[a]	3.7[b]	0.02
Lactose	4.47[b]	4.26[c]	4.69[a]	4.49[b]	0.03
Ash	0.95	0.94	0.99	0.98	0.04

Means with different letter in the same row are significantly different at ($p<0.05$).
R (1): Ewes fed 70 % CFM + 30 % Berseem hay
R (2): Ewes fed 70 % CFM + 30 % olive tree by-products
R (3): Ewes fed 70 % CFM + 30 % olive tree by-products treated with urea.
R (4): Ewes fed 70 % CFM + 30 % olive tree by-products treated with *P. chrysosporium.*