

EFFECT OF TREATED BARLEY STRAW WITH TRICHODERMA HARZIANUM FUNGI IN SOME PRODUCTIVE CHARACTERISTIC

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Abstract – This study was conducted at the farm of Ruminants Research Station / Office of Agricultural Research / Ministry of Agriculture / in Abu Ghraib – Baghdad. The experiment was continued for 63 days in addition to the adaptation period for 14 days from 11/10/2015 until 13/12/2016 to study the effect of the treatment of barley straw with fungi (*Trichoderma harzianum*) in some productive characteristics. Six Awassi lambs were used in this experiment with average initial weight of 38 ± 0.50 kg and aged 8-9 months. Lambs were divided randomly into two equal groups, and then put with individual pens. Lambs were fed individually on a unified concentrate diet (2.5% of body weight). While, the roughages offered on ad libitum basis. Each group were fed on roughages (barley straw), as follows:

1. The First group was a control group fed on untreated barley straw.
2. The second group was fed on barley straw treated with *Trichoderma harzianum* at rate 0.1% (1 kg /tonnes).

The animals were weighted every two weeks before the morning feeding. The digestibility experiment was performed in the seventh week. The rumen liquor was collected at fifth week from experiment from at three periods (before feeding, after three and six hours from feeding). An analysis of the statistical data using the program of statistical analysis (SAS) and the experience was the use of (CRD). The results showed that different effects among treatments as follow: The fungi was not significantly effected on the feed intake, digestibility, and rumen characteristics. (pH and NH₃-N), While found a significant decrease ($P < 0.05$) in the hemicelluloses content with *Trichoderma* fungi treatment compared with control (5.09 and 7.37, respectively). Moreover, found a significantly decrease ($P < 0.05$) in weight gain in the fourth and sixth weeks with fungi (214.29 and 60.71, respectively), compared with control (250.00 and 160.71, respectively), and found a significantly increased ($P < 0.05$) in weight gain in the (2 and 8 weeks) (64.29 and 160.71, respectively), compared with control (48.33 and 142.86, respectively). Found a significantly increased ($P < 0.05$) in feed conversion ratio with *Trichoderma* fungi treatment compared with control (8.22 and 18.93, respectively), and found a significantly increased ($P < 0.05$) the total counts of microorganisms in the period (0 and 3) for fungi compared with control (1.48×10^{10} , 3.30×10^{12} and 4.30×10^4 , respectively). We conclude from the foregoing that the treatment of fungi (*Trichoderma harzianum*), was positive improvements on the performance of Awassi lambs.

KeyWords: Barley straw, Harzianum fungi

I. INTRODUCTION

Raising sheep in Iraq are suffering a lot of obstacles and problems of the most important problems of nutritional where the advantage of Iraq, down spaces pastures as well as low areas allocated for cultivation of green fodder, which is not consistent with the needs and the preparation of Animals [5] so many researchers to resort to the use of low forage quality that characterized by low value and contain a high percentage of lignin [25].

Many of the treatments were conducted to improve the nutritional value of low feed quality including physical, chemical treatments [6, 19] and biological treatments [20], which helps to breaking the link between the lignin and cellulose and increased cellulose free for ease of use it by ruminant animals [25].

Microbiology used in biological treatments are fungi and the search is still going to know the best and qualified this fungus in improve the nutritional value of the forage and these fungus under discussion is *Trichoderma harzianum* of the division of *Ascomycota* It is of a kind used to breaking the link between the lignin and cellulose [26]. The *Trichoderma*

characterized by fast growth and working to improve digestibility and have the ability to produce many of the enzymes of these enzymes Cellulase, β -Xylosidase and Xylanase [29, 37].

Therefore, the purpose of this study was to know the effect of the treatment of barley straw with fungi (*Trichoderma harzianum*) in the performance of the Awassi Lambs.

II. MATERIALS AND METHODS

This study was conducted in the farm of Ruminants Research Station / Office of Agricultural Research / Ministry of Agriculture / in Abu Ghraib – Baghdad. The experiment was continued for 60 days in addition to the introductory period for 14 days from 11/10/2015 until 13/12/2016

1. The purpose of the study

Study the effect of the treatment of barley straw with fungi *Trichoderma harzianum* in some productive characteristics (feed intake, average daily gain and feed conversion ratio) digestibility, and rumen characteristics (ruminal pH,

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ammonia-N concentration and the total counts of microorganisms).

2. The preparation of forage components

2.1. Forage

Lambs were fed individually on a unified concentrate diet (2.5% of body weight). While, the roughages offered on ad libitum basis and took samples of it for the purpose of conducting chemical analyzes Table (1) shows the chemical composition of barley straw and concentrate diet.

Table (1) the chemical composition of barley straw without treatment (T₁) and barley straw treatment (T₂) and concentrate diet (% of dry matter)

Factor(%)	Treatments		Concentrate
	T ₁	T ₂	
DM	90.83	91.78	6.94
CP	3.79	3.63	11.09
CF	58.56	58.36	11.97
EE	1.25	1.27	4.703
NFE	12.78	11.37	62.15
ASH	13.13	15.74	6.94
NDF	63.68	63.48	41.1
ADF	42.02	40.45	18.5
ADL	24.08	20.06	5.02
ME MJ/kg DM	4.63	4.37	11.66

ME (MJ/kg DM) = $[-0.45 + (0.04453 \times \% \text{TDN})] \times 4.184$ [24]

2.2 . Method of treatment barley straw

Barley straw has been divided into three groups was lifted humidity to 70% by spraying water on it and has treated each section as follows: -

1. The first group did not be treated offers a control group which is used to display a comparison.
2. The second group was treated with fungi (*Trichoderma harzianum*) 0.1% (1 kg / ton) has melting ingredients in water (100 g / 10 liters) containing liquid was sprayed on the fungi on barley straw and mixing the barley straw to making sure distribute fungi

After spraying treatment material ends were covered barley straw by a black bags of polyethylene to prevent the air and the sun light, left for two weeks and then was removed the bags of polyethylene for barley straw. Left to dry and then was grind barley straw for using it and submit it to the experience animals.

3. Experience growth

Six Awassi lambs were used in this experiment with average initial weight of 38 ± 0.50 kg and ages rate 8-9 months. Lambs were divided randomly into two equal groups (3 for each group) and then put with individual pens The area (1.25×1.25) are numbered according to transactions. Lambs were fed individually on a unified concentrate diet for all groups. The adaptation period amounting 14 day offered fodder gradually the roughages were introduced separately from concentrate diets at 8:00 am. The concentrate diets

provides at 12 pm to ensure eating a larger amount of roughages.

The following day collects the remains of roughages and concentrate every day in the morning before fodder for calculating the amount of the daily feed intake. The animals were weighted every two weeks before the morning feeding and periodically at the beginning of the experiment to the end.

4 Experience digestion

Experiment was conducted estimate digestibility during the seventh week of the experiment of all the animals. Only feces were collected for a period of 7 days in the morning of each animal before provision of food by using the bags to collect feces locally made from flour bags containing small holes at the bottom, then it was weighed by electronic balance, and take a sample of it and put in a small and clean plastic bag to save it in the fridge. The process is repeated on the second day, and so for a period of 7 days, and take a sample later and kept in the refrigerator (freeze) until the holding of chemical analyzes later.

5. Chemical analysis

It was conducted analytical chemical feed and feces to find all of the dry matter (DM), organic matter (OM), Ash, crude protein (CP), crude fiber (CF), ether extract (EE) [23], neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), [18], cellulose and hemicelluloses.

6. Rumen Fermentation Characteristics

Rumen liquor samples were collected from lambs during the fifth week of the experiment. They were withdrawn at zero time (just before feeding), and then at 3 h and 6 h post morning feeding to study rumen fermentation characteristics through the determination of the ruminal pH, NH₃-N concentrations, and total counts of microorganisms. Samples were withdrawn from the same animals in all sampling time by using a smooth rubber stomach tube which connected to Hand Operated Siphon Pump (SI-60) and inserted into the rumen via the esophagus as described by [30]. Rumen liquor was strained through four layers of cheesecloth to discard the solid unfermented particles and immediately measured for pH using Portable digital pH meter (ph-80) after adjusting with standard pH buffer solutions (pH=7). After that, it was a retention of about 10 ml of the rumen liquor add 2-3 drops of toluene to prevent fermentation. The samples stored at -20 °C until analysis and 10 ml of rumen liquor for the purpose total counts of microorganisms after combining directly [16].

7. Statistical analysis:

The experiment data analysis in a complete randomized design (CRD) and compared the moral differences between the averages Duncan test multi – border [11] and use statistical program SAS [33] in the analysis.

III. RESULTS AND DISCUSSION

The results showed that different effects among treatments as follow:

1. Feed intake

Table 2 shows the treatment with fungi did not have any significant effect on the amount of intake of roughages, concentrate diet and total. These results agreed with [9, 13, 22] and did not agree with [2, 15, 17, 28].

It may be not effect or reduce the treatments of total feed intake because of the large ages of animals or because of the fact that we have adopted in this study to treat barley straw instead of using these materials fodder as additives with the feed position as at previous studies and this may have a role in the decline in animal palatable to feed some treatments.

2. The chemical composition of roughages

Table 2 shows the treatment with fungi did not have any significant effect on the amount of dry matter (DM), organic matter (OM), Ash, crude protein (CP), crude fiber (CF), ether extract (EE), cellulose, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). While found a significant decrease ($P < 0.05$) in the hemicelluloses content with *Trichoderma* fungi treatment compared with control (5.09 and 7.37, respectively). These results agree with [8, 12, 13], while did not agree with [1, 35, 37, 38].

These results did not agree with [4], which reported to decrease in NDF, ADF and ADL, which can be an indication of the disintegration of the cell wall components of the material basis because of extracellular enzymes secreted from fungus. While found increase the digestion it was associated with the disintegration of carbohydrates structural and found increase in the crude protein content of the corn husk when treated with the fungus mold White. The decrease in crude fiber content may be relate to take advantage of carbohydrate by the fungus as an energy source for the growth of fungoid.

Table 2 effect of treatment with *Trichoderma harzianum* fungi in feed Intake

Treatments Intake Kg/d	Control	Trichoderma	signi
Roughages	34.02 ± 2.86	31.86 ± 2.02	NS
Concentration	16.47 ± 1.32	13.36 ± 0.65	NS
Total	50.49 ± 3.89	45.22 ± 2.25	NS
DM	30.90 ± 2.60	28.93 ± 1.84	NS
CP	1.29 ± 0.11	1.42 ± 0.09	NS
CF	19.92 ± 1.67	19.09 ± 1.21	NS
EE	0.43 ± 0.04	0.37 ± 0.02	NS
Cellulose	6.11 ± 0.51	7.38 ± 0.47	NS
Hemicelluloses	7.37 ± 0.62 a	5.09 ± 0.32 b	*
NDF	21.67 ± 1.82	20.72 ± 1.32	NS
ADF	14.30 ± 1.20	15.64 ± 0.99	NS
ADL	8.19 ± 0.69	8.26 ± 0.53	NS

* = significant on ($P < 0.05$), NS = non-significant

3. Daily gain and feed conversion ratio

Table 3 shows the treatment with fungi did not have any significant effect on the average final weight and total weight. While found a significantly decrease ($P < 0.05$) in weight gain in the fourth and sixth week (214.29 and 60.71, respectively) for fungi compared with control (250.00 and

160.71, respectively). Found a significantly increased ($P < 0.05$) in daily gain weight (second, and eighth week) (64.29 and 160.71, respectively) compared with control (48.33 and 142.86, respectively), and found a significantly increased ($P < 0.05$) in feed conversion ratio with fungi compared with control (8.22 and 18.93, respectively). These results do not agree with [1, 2, 9, 15, 17, 22]. It may be not affect the treatments in the characteristics because of the large ages of animals. These results of feed conversion ratio agree with [1, 2, 9, 15, 17, 22].

Table 3 effect of treatment with *Trichoderma harzianum* in average final weight, total weight, daily gain weight and feed conversion ratio

Treatments Characteristics	Control	Trichoderma	Signi
Initial weight (kg)	38.53 ± 4.34	38.03 ± 0.26	NS
Final weight (kg)	43.83 ± 2.40	43.75 ± 1.01	NS
Daily gain weight			
Week 2	48.33 ± 1.67 b	64.29 ± 1.74 a	*
Week 4	250.00 ± 9.71 a	214.29 ± 8.24 b	*
Week 6	160.71 ± 10.31 a	60.71 ± 10.80 b	*
Week 8	142.86 ± 7.55 b	160.71 ± 10.31 a	*
Total gain weight	5.30 ± 0.16	5.72 ± 0.750	NS
Feed conversion ratio	18.93 ± 1.30 a	8.22 ± 1.30 b	*

* = significant ($P < 0.05$), NS = non-significant

4. Digestibility

Table 4 shows the treatment with fungi did not have any significant effect on the digestibility of dry matter (DM), organic matter (OM), Ash, crude protein (CP), crude fiber (CF), ether extract (EE), cellulose, hemicelluloses, neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). These results agreed with [27, 38] and did not agree with [1, 3, 13, 15, 26, 28, 32, 35, 37], and did not agree with [7], which suggested that improvement of digestion coefficient of both crude protein (CP) and crude fiber (CF) might due to enzymes produced by microbes (specially amylase and protease) which were involved indirectly in the digestion of carbohydrate and protein. They suggested that the increase in Digestible crude protein may be attributed to better digestibility of most nutrients due to this treatment or the increase in fermentation capacity of the rumen [21].

Table 4 effect of treatment with *Trichoderma harzianum* fungi in digestibility

Treatments Digestibility %	Control	Trichoderma	signi
DM	81.38 ± 3.84	77.00 ± 2.20	NS
CP	94.74 ± 1.05	97.40 ± 0.76	NS

CF	83.28 ± 2.47	77.90 ± 2.51	NS
EE	96.82 ± 0.44	96.32 ± 0.46	NS
Cellulose	84.68 ± 6.41	88.61 ± 1.95	NS
Hemicelluloses	85.09 ± 2.47	82.41 ± 3.55	NS
NDF	86.55 ± 3.02	85.64 ± 1.98	NS
ADF	87.78 ± 3.60	87.56 ± 1.23	NS
ADL	91.59 ± 0.20	86.42 ± 4.94	NS

NS = non-significant

5. Rumen Characteristics

Table 5 shows the treatment with fungi did not have any significant effect on rumen characteristics (pH, NH₃-N concentration) in all periods, and the total counts of microorganisms (3 and 6 periods). While found a significantly increased (P <0.05) the total counts of microorganisms in the period (0 and 3) for fungi compared with control (1.48*10¹⁰, 3.30*10¹² and 4.30*10⁴, respectively). These results did not agree with [1, 3, 10, 13, 14, 31]. The results of the total counts of microorganisms agree with [1, 3, 10, 13, 14, 31].

The addition of the fungus can work to stabilize the pH of the rumen in the first place by encouraging the growth bacteria consumed lactic, which is responsible for the reduction of the concentration of lactate in the rumen [36], but as we have seen that in our study did not find any effect on the pH.

These results did not agree with [34] which the fungi maintained a stabilized ruminal pH and consequently a higher cellulolytic activity in the rumen.

Table 5 effect of treatment with *Trichoderma harzianum* in Rumen Characteristics

Periods Treatments	0	3	6
Control	6.35 ± 0.05	6.45 ± 0.15	6.35 ± 0.05
pH			
Trichoderma	5.80 ± 0.30	6.30 ± 0.30	5.80 ± 0.30
Significantly	NS	NS	NS
Total counts			
Control	4.30*10 ⁴ ± 0.30 b	1.09*10 ⁴ ± 0.46 b	3.80*10 ¹² ± 0.38
Trichoderma	1.48*10 ¹⁰ ± 0.28 a	3.30*10 ¹² ± 0.27 a	5.48*10 ¹² ± 0.45
Significantly	*	*	NS
NH ₃ -N mg / dcl			
Control	31.52 ± 3.50	31.52 ± 3.50	24.52 ± 3.51
Trichoderma	28.02 ± 7.33	28.02 ± 7.33	28.02 ± 7.00
Significantly	NS	NS	NS

NS = non-significant,

CONCLUSIONS

1. The treatment with fungi (*Trichoderma harzianum*) did not have any positive effects on productive characteristics feed intake, digestibility, and rumen characteristics (ruminal pH and ammonia-N concentration).

2. The treatment with fungi (*Trichoderma harzianum*) improved the average daily gain, feed conversion ratio and total counts of microorganisms.

Recommendations

1. Using different concentrations of the fungus *Trichoderma*.
2. Using different periods lap to figure out the best lap time to give the best to improve the nutritional value of the roughages.
3. Using of animals smaller reconstruction of used in this study because of reconstruction may have a negative effect on the treatment does not give us a real idea about the effectiveness of these transactions where are wasted high in large animals age.
4. Modern ways of thinking and techniques to improve the quality of agricultural waste for the purpose of take advantage of them and their use in ruminant feed.
5. The observed decrease in crude fiber (CF) content of treated sugar beet pulp diets might be due to the utilization of CF during the incubation period by fungi for their growth because fungi among all microorganisms have been proven for their capability in decomposing the agro-industrial by-products. They use these by-products as carbon sources to grow up and convert them into microbial protein.

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