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EFFECT OF FEEDING RATIONS CONTAINING GRADED LEVELS OF BIOLOGICALLY TREATED WHEAT STRAW ON CARCASS CHARACTERISTICS AND SOME BLOOD PARAMETERS OF GROWING LAMBS.

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SUMMARY

Twenty-four Rahmani lambs with average body weight 14.00±0.30 kg and six months old were used in this study. Lambs were distributed into four roups (6 lambs each). Animal groups were fed the four respective rations as follows: first (R1) was the control group fed hay and concentrate feed mixture (CFM), R2, R3 and R4 replaced 25, 50 or 75% of CFM protein with wheat straw treated with fungus, the experiment extended for 180 days. Animals were weighed monthly to calculate weight gain, daily weight gain and feed efficiency. Blood samples were taken from three animals of each group to evaluate the liver and kidney functions. After the end of the feeding trial the animals were fed the same rations for each group until the animals reached the common market weight (40 kg in average). Thereafter, three lambs from each group were chosen randomly and slaughtered to study the carcass characteristics. The data revealed that the final weight was higher in the control than the treated groups, while, no significant differences (P>0.05) were found between treated groups in total and daily weight gain Dry matter intake was slightly increased by increasing the proportion of the treated wheat straw in the ration. On the other hand, better feed efficiency (kg DMI/kg gain) was recorded for groups fed rations containing either 25 or 50% treated wheat straw compared to those fed 75% while, the lambs fed control ration had the best feed efficiency. Abdominal fat and edible offalls weight significantly differed among groups, while animals in R3 group showed the highest abdominal fat weight (0.90 kg). Shoulder and hind quarters weights did not differed significantly (P>0.05) among the groups. Also, no significant differences were found in respect of lion, rack, brisket, flank and weight among the groups However, lambs in R3 group showed the highest lion and brisket neck weight while the smallest cut weight recorded in the R4 group Dressing percentage (relative to fasting weight) was significantly different among the groups. Lambs from the control group showed the highest dressing percentage, while lambs from the R3 group had higher dressing percentage as compared to other treated groups. Physical characteristics of best ribs (9-10 and 11) showed the highest fat content in the control group while, the lean percentages was lower in control than in the R4 group.

The boneless meat percentage (lean + fat weight) was significantly different among the groups. R4 group showed higher value than the other groups. The chemical composition of meat showed that there were significant differences among the treatments in ether extract (EE), crude protein (CP) and ash content. Lambs from the R2 group had the highest value of EE, and lowest value of CP in meat samples. Also, blood serum values of total proteins, albumin and globulin were significantly affected by the treatments while, no significant differences were found among the different treatments in respect of ALT, AST activity and creatinine content.

Keywords: biological treatment, carcass characteristics, blood parameters and lambs

INTRODUCTION

Shortage in animal feeds has been found to have a negative impact on the development of animal production in Egypt. Feed shortage has been estimated to be 6 million tons in term of concentrate (Agriculture Economic and Statistics Institute, 2006). Most of the developing countries have to import animal feeds, which is not economically feasible. Recently, price of corn grain increased dramatically. Therefore, more attention was given to agro-industrial by-products. Non traditional feed resources such as crop residues and agro-industrial by-products must be searched in order to decrease the relay on traditional resources, to cover the nutritional gap in animal feeds and to decrease feeding costs (Zaza, 2005).

The primary factors limiting the utilization of field crop residues are their low palatability, low protein content and low organic matter digestibility. The low digestibility is attributed to their high cellulose (30-40%), hemicellulose (25-35%) and lignin (10-15%) content in the dry matter (Theander and Aman, 1984).

Biological treatment is used for increasing the nutritional value of many by-products, because they have significant concentration of carbohydrates, such as mono-and disaccharides. For these reasons the microbial conversion of these by-products may improve their nutritive value and transforming them into high quality animal feed (Villas-Boas *et al.*, 2002).

The first aim of present study was to investigate the ability of biological treatment of wheat straw with (*Trichoderma viride* F-416) to improve its chemical composition. The second purpose was to investigate the effect of replacing graded levels of concentrate feed mixture (CFM) crude protein (CP) content with the CP of biologically treated wheat straw in ration for growing lambs and its effect on carcass characteristics.

MATERIALS AND METHODS

Strain of *Trichoderma viride* F-416 (*T. viride*) was obtained from Microbial Chemistry Department, National Research Center, Dokki, Cairo, Egypt. Commercial ready made feed was purchased from a local feed mill. CFM, wheat straw and treated wheat straw was chemically analyzed according to A.O.A.C. (1990) method. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined by the method of Van Soest (1994).

Twenty-four six months old Rahmani lambs with average body weight 14.00±0.3 kg were used in the feeding trial. Lambs were distributed into four similar groups (6 lambs each). The animal groups were fed randomly to one of the following rations: The first (R1) was the control group fed hay and CFM. R2, R3 and R4 replaced (25, 50 and 75%) of CFM protein by dry fungal treated wheat straw. The diet was weighed before feeding and given in two equal portion at 8:00 a.m. and 3:00 p.m, daily for 180 days. The residues if any was weighed at next day before feeding. All lambs were fed according to NRC (1985) recommendations. Animals were weighed monthly to calculate total weight gain, daily weight gain and feed efficiency (feed to gain ratio). At the same time blood samples were taken from three animals of each group. Blood samples were taken from the jugular vein and centrifuged for 20 min at 3000 r.p.m. The obtained plasma fraction was frozen and stored at -20°C for subsequent analysis. Total protein content was determined according to Armstrong and Carr (1964); albumin content according to Doumas *et al.* (1971); AST and ALT activities according to Reitman and Frankel (1957) and creatinine content according to Folin (1994).

After the end of feeding trial three lambs from each group were chosen randomly and then they were fasted for 16 hours prior to slaughter. Animals were weighed immediately before slaughtering and the fasting weight was recorded. When bleeding was completed the lambs were skinned, dressed out, and the hot carcass was weighed. The weights of non edible offals (head, pelt, four feets, full gastrointestinal tract and empty gastrointestinal tract) were recorded. Weights of the edible offals (liver, kidney, testicles, spleen, heart and lunges) were also recorded. The main carcass cuts (shoulder, legs, loin, neck, rack, brisket and flank) were weighed and recorded. Also internal fat and kidney fat were weighed and recorded. The data were statistically analyzed according to Sendecor and Cochran (1980) using SAS statistical software (1985). The difference between means was tested by Duncan's multiple range test (1955).

RESULTS AND DISCUSSION

Chemical composition of feed:

Chemical composition of wheat straw, biologically treated wheat straw, hay and CFM are presented in Table (1). Treated of wheat straw with *T. viride* resulted decrease in DM, OM and CF from 91.03 to 86.49% from 88.60 to 86.93% and from 39.30 to 30.10%, respectively. The CP and ash content were increased in biologically treated wheat straw from 4.10 to 10.94% and from 11.40 to 13.75%, respectively. These results are in agreement with those reported by Chawla and Kunda (1985) and Gupta and Langer (1988). Dahanda *et al.* (1994) found that CP content of spent straw increased from 3.42 to 6.19%. On the other hand the NDF, ADF, ADL, cellulose and hemi-cellulose content in treated wheat straw were a decreased as a result of biological treatment, from 80.40 to 64.50%, from 48.52 to 40.50%, from 10.30 to 8.50%, from 38.22 to 32.00% and from 31.88 to 24.00%, respectively. These results agreed with those obtained by (El-Ashry *et al.*, 2002 and Gado *et al.*, 2007).

Table (1): Chemical composition of experimental feed_ingredients used in experimental rations (% on DM basis).

Item	Wheat straw	Treated wheat straw	Hay	Concentrate feed mixture
DM	91.03	86.46	89.00	91.20
OM	88.60	86.93	89.19	87.50
CP	4.10	10.94	13.05	16.10
CF	39.30	30.10	35.51	14.01
EE	1.20	1.02	1.94	4.29
NFE	44.00	44.87	38.69	53.10
Ash	11.40	13.75	10.81	12.50
Fiber fractions:				
NDF	80.40	64.50	74.01	39.00
ADF	48.52	40.50	55.50	23.00
ADL	10.30	8.50	8.73	6.30
Cellulose	38.22	32.00	46.77	16.70
Hemicellulose	31.88	24.00	18.51	16.00

Feeding trial:

The mean values of daily weight gain, feed intake and feed efficiency are shown in Table (2). The data revealed that the final body weight was higher in the control than the treated groups. No significant differences were found among the groups neither in total weight gain nor in daily weight gain. The data showed that the total daily dry matter intake (g/head/day) increased by the increase of the supplementation of treated wheat straw in the ration (1372, 1517, 1588 and 1652 for R1, R2, R3 and R4, respectively). This might due to the decrease of the quantity of CFM in the daily ration fed to the experimental groups and higher consumption of straw by the groups fed fungal treated wheat straw. In this respect, these results are in agreement with those reported by Deraz (1996) and Sabbah *et al.*, (2006) who showed that growing lambs fed on fungal treated roughages showed higher daily weight gain as compared to the control group. El-Marakby (2003) recorded better feed conversion values for lambs fed rations where 25 and 50% CFM proteins replaced with biologically treated (*T. harzinaum*) wheat straw. In that experiment the lambs were fed *ad libitum* than that for lambs fed control by 5.34, 3.25 and 8.69%, respectively. Deraz (1996) and Sabbah *et al.*, (2006) found that animals fed biologically treated roughages were the most efficient groups followed by those fed chemically treated roughages. Rates of improvement in feed conversion ratio as kg DMI/kg weight gain were 9.73, 6.07 and 7.55% for groups fed rations containing biologically treated wheat, bean and clover straws, respectively.

Table (2): Effect of feeding graded levels of biologically treated wheat straw on growth performance of experimental lamb groups.

Item	Experimental rations			
	R1	R2	R3	R4
No. of animals	6	6	6	6
Duration of trial (days)	180	180	180	180
Initial live body weight (I.B.W), kg	14.35	14.38	14.35	14.34
Final live body weight (F.B.W), kg	41.00	40.66	41.36	39.33
Total weight gain, kg	26.65	26.28	27.01	24.99
Daily weight gain, g	180.0	146.0	150.0	138.8
Daily feed intake				
Concentrate (DMI), g	733	530	350	171
Hay (DMI), g	639	627	619	594
Treated wheat straw (DMI), g	-	360	609	887
Total DMI, g	1372	1517	1578	1652
Feed efficiency				
DMI kg/kg weight gain	9.26^{c}	10.39^{b}	10.51^{b}	11.89^{a}

[a,b] and [c] Means with different superscripts in the same row differ significantly ($P<0.05$).

Carcass trait:

The slaughter characteristics are presented in Table (3). The average fasting body weight of R3 group was significantly higher than there of the other treated groups while, the control group had the same figure. The R4 group showed the lowest fasted body weight (39.33 kg), and the differences were significant among R4 and other groups ($P<0.05$). Data in Table (3) also showed that the amount of of abdominal fat (internal fat, kidney fat and heart fat) were significantly different among the groups, where R3 showed the highest abdominal fat weight (0.90 kg). The same trend was also obtained concerning weight of the edible offal. These results are in agreement with El-Refaey (2006) who found that total edible offal weight was significantly different among studied groups of biologically treated roughages. The hot carcass cuts presented in Table (3) showed that the shoulder and hindquarters weights did not differ among the groups. Also, lion, rack, brisket, flank and neck weights had no significant differences between groups, while lambs in the R3 group had the highest lion and brisket and weight and R4 group showed the smallest cuts weight. Tail weight differed significantly among the experimental groups. Lambs fed on 75% treated wheat straw had the highest value (1.40 kg) while lambs fed on control ration had the smallest (1.05 kg).

Table (3): Effect of feeding graded levels of biologically treated wheat straw on carcass characteristics of experimental lambs group.

Item	Experimental rations				Overall
	R1	R2	R3	R4	SEM
Fasting weight, kg	41.00[a]	40.66[a]	41.36[a]	39.33[b]	0.71
Hot carcass weight (kg)	18.65[a]	17.36[c]	18.00[b]	16.82[d]	0.40
Edible offal weight (kg)*	1.62[b]	1.58[c]	1.65[a]	1.51[d]	0.03
Abdominal fat weight (kg)	0.70[b]	0.10[a]	0.90[a]	0.60[c]	0.14
Shoulder (kg)	3.69	3.37	3.42	3.36	0.07
Hind quarter (kg)	5.86	5.37	5.41	5.19	0.12
Lion (kg)	1.16	1.22	1.28	1.15	0.03
Rack (kg)	3.24	3.17	3.23	3.15	0.07
Brisket (kg)	0.79	0.72	0.83	0.78	0.04
Flank (kg)	0.90	0.87	0.86	0.94	0.08
Neck (kg)	1.31	1.48	1.38	1.35	0.04
Tail (kg)	1.05[c]	1.19[b]	1.18[b]	1.40[a]	0.82

[a, b, c] and [d] Means with different superscripts in the same row differ significantly (P<0.05).
* Edible offal = (lungs, heart, liver, kidney and spleen).

Physical characteristics of muscle :

The average dressing percentage and physical characteristics of eye muscle are presented in Table (4). Dressing percentage (relative to fasting weight) was significantly different among the groups. The control group showed the highest dressing percentage. The dressing percentage for group R3 was higher than the other treated groups being 43.52, 42.77 and 42.70 for R3, R4 and R2, respectively (Table 4). El-Marakby (2003) reported that, the pre-slaughter live body weight was significantly (P<0.01) increased in lambs fed 50% CFM + biologically treated rice straw with *Agricus bisporus* fungus comparing with those fed ration containing untreated rice straw (control). Also, dressing percentage on the basis of live body weight, as well as, fasted body weight and empty body weight were slightly higher for lambs fed rations containing biologically treated rice straw with *Agricus bisporus* fungus as compared to untreated control. While, it is clear that, there was no significant effect on carcass weight among the experimental groups. Physical characteristics of best ribs (9-10 and 11) showed that R4 group had significantly (P<0.05) higher best ribs weight than the other treated groups. However, the highest fat percentage (7.52%) was recorded in the control group, while R4 group had the lowest fat percentage (4.62%) and the differences between these groups were significant (P<0.05). These results might be attributed mainly to lower consumption from concentrates by group R4. The same trend was found in the lean percentage which was lower in control group than R4 treated groups being 66.98, 66.55, 58.81 and 72.54% for R1, R2, R3 and R4 groups, respectively (Table 4). These results are in agreement with the findings of El-Refaey (2006). Table (4) also showed that lambs in group R4 showed the lowest bone percentage while R1 had the highest and the differences were significant. The boneless meat percentage (lean + fat weight) was significantly different among the treatment groups, It was the highest in R4 group which was followed by the other treatment groups (R2 and R3) and control (R1) had the smallest boneless meat percentage.

Table (4): Effect of feeding graded levels of biologically treated wheat straw on dressing percentage and physical characteristics of eye muscle of experimental lambs group.

Item	Experimental rations				Overall SEM
	R1	R2	R3	R4	
Dressing percentage	46.23[a]	42.60[c]	43.48[b]	42.80[bc]	0.85
Sample weight , g	372.50[a]	342.67[b]	337.33[b]	374.00[a]	16.56
LD area (cm^2)	14.88[a]	11.67[c]	12.00[c]	13.67[b]	0.81
Sample fat, g	28.00[a]	23.33[ab]	16.67[c]	20.00[bc]	5.55
Fat percentage	7.52[a]	7.08[a]	5.22[b]	4.62[b]	1.52
Sample lean meat, g	248.00[b]	228.00[c]	198.67[d]	270.00[a]	13.01
Lean percentage	66.98[b]	66.55[b]	58.81[c]	72.45[a]	1.98
Sample bone weight, g	97.50[a]	85.33[b]	95.33[a]	73.33[c]	5.97
Bone percentage	26.30[b]	24.37[c]	27.93[a]	20.16[d]	1.32
Boneless meat percent	73.70[c]	75.63[b]	72.07[d]	79.84[a]	1.32

[a,b,c] and [d] Means with different superscripts in the same row differ significantly (P<0.05).

Chemical composition of meat:

The chemical composition of the 9-10 and 11 rib sections of studied groups are shown in Table (5). Regarding the chemical analysis, it is obvious that there were significant differences among treatments in ether extract (EE), CP and ash content. R2 and R3 groups showed the highest values of EE being 20.50 and 19.65%. On the other hand, R1 and R4 groups had the lowest EE content, but the CP content were higher in meat samples of control and R4 groups (76.57 and 76.81%), while R2 group had the lowest values of protein content (71.21%). There were no significant differences among the groups in the Ca and P content (Table 5). The chemical composition of meat in the present study for CP and EE percentage are within the normal range reported in lamb meat by El-Ayek *et al.*, (2002); Awadalla *et al.*, (2002) and Ahmed (2003). The ash content of meat samples in the present study was lower than those reported by the previously mentioned authors. This may be attributed to different experimental rations and different treatments.

Table (5): Effect of feeding graded levels of biologically treated wheat straw in rations on chemical composition of lamb meat.

Item	Experimental rations				Overall SEM
	R1	R2	R3	R4	
Ether extract (%)	20.50[a]	19.65[a]	17.65[a]	13.28[c]	1.25
Crude protein (%)	76.57[a]	71.21[c]	73.64[b]	76.81[a]	1.39
Ash (%)	5.79[c]	8.29[b]	6.72[c]	9.91[a]	1.22
Ca (mg/g)	14.41	14.28	14.50	14.45	0.03
P(mg/g)	6.62	6.85	7.24	6.59	0.02

[a,b] and [c] Means with different superscripts in the same row differ significantly (P<0.05).

Blood parameters:

The effect of experimental rations on some blood parameter of lambs is shown in Table (6). The results showed that total proteins, albumin and globulin content of blood plasma were significantly ($P<0.05$) affected by treatments. The overall means of total protein in all treatments ranged from 60.3 to 73.9 g/L. The highest total protein content was recorded in the control group. In the treated groups R3 had the higher total protein content (64.4) as compared to 60.6 and 60.3 g/L for groups R2 and R4, respectively. Kumar *et al.*, (1980) reported that there was a positive correlation between dietary protein intake and blood plasma protein concentration. Shehata *et al.*, (2003) reported that total protein concentration ranged from 60.3 to 75.3 g/L for growing lambs fed ration containing maize silage, and CFM. However, Rowland (1980) found that the dietary protein can affect on the concentration of blood serum total proteins content in animals especially when it was low concentration in diet. Total protein content of blood serum in sheep was ranging between 66 and 136 gm/100ml as reported by Salah (1992). No significant differences were found in blood serum total protein, albumin, globulin concentrations, and activities of AST and ALT when lambs were fed either control rations, 25, 50% untreated SBP or treated SBP with *Trichoderma reesei* as was found by El-Badawi *et al.* (2007).

Table (6): Effect of feeding graded levels of biologically treated wheat straw on some blood serum parameters of experimental lambs group.

Item	Experimental rations				Overall
	R1	R2	R3	R4	SEM
Total protein (g/L)	73.9^{a}	60.6^{c}	64.4^{b}	60.3^{c}	8.60
Albumin (g/L)	39.1^{a}	35.0^{c}	36.0^{b}	35.2^{c}	16.0
Globulin (g/L)	34.8^{a}	25.6^{c}	28.4^{b}	2.51^{c}	5.80
A/G ratio	1.12	1.36	1.26	1.40	1.03
Creatinine (mg/L)	16.9	16.6	16.2	16.3	5.00
ALT (IU/L)	35.07	34.96	34.89	35.02	0.60
AST (IU/L)	60.52	61.10	59.96	60.11	1.26

$^{a, b}$ and ^{c} Means in the same raw with different super script are significantly ($P<0.05$) different.

CONCLUSION

In conclusion the replacement of concentrate feed mixture protein by fungal treated wheat straw revealed an increase in DM intake and meat ash content while, decreased feed efficiency, hot carcass weight, dressing percent, also total blood serum protein, albumin and globulin content.

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تأثير التغذية على علائق بها نسب متزايده من تبن القمح المعامل بيولوجيا على صفات الذبيحة و بعض مكونات الدم فى الحملان النامية

فاتن فهمي أبو عمو ، طارق محمد محمد عبد الخالق ،أحمد عبد الرحمن محروس و محمد حسن الشافعي
معهد بحوث الإنتاج الحيواني ـ مركز البحوث الزراعية ـ الدقى ـ الجيزة ـ مصر.

أستخدم فى هذه الدراسة عدد ٢٤ حولي رحماني بمتوسط وزن ابتدائى ١٤.٤ كجم ومتوسط عمر ستة أشهر وزعت الحيوانات على أربعة مجاميع متشابهه بواقع (ستة حوالى بكل مجموعة). غذيت المجاميع طبقا لمقررات NRC (1985). المجموعة الأولى غذيت على العلف المركز و دريس البرسيم و المجاميع الثانية و الثالثة و الرابعة تم إستبدال (٢٥ ، ٥٠ و ٧٥٪ على التوالي) من بروتين العلف المركز ببروتين تبن القمح المعامل بفطر T. viride. تم وزن الحيوانات شهريا لحساب الزيادة الكلية و الزيادة اليومية وكذلك كفاءة إستهلاك الغذاء. ثم أستمرت الحيوانات فى التغذية على نفس العلائق حتى وزن التسويق الشائع (٤٠ كجم). تم إختيار ثلاث حيوانات عشوائيا من كل مجموعة و ذبحت لدراسة صفات ومكونات الذبيحة.

أوضحت النتائج أن الوزن النهائي كان أعلى فى مجموعة الكنترول عن بقية المجاميع فى حين لم يكون هناك إختلاف معنوي بين المجاميع فى الزيادة الكلية أو الزيادة اليومية فى الوزن في حين كان هناك زيادة فى معدل إستهلاك الغذاء فى مجاميع المعاملة عن مجموعة الكنترول.

كان هناك إختلاف معنوي بين المجاميع فى دهن البطن و مجموع الأعضاء المأكولة فى حين لم يكن هناك إختلافات معنوية بين المجاميع فى وزن القطعيات الرئيسية للذبيحة فى حين سجلت المجموعة الرابعة أقل وزن فى كل قطعيات الذبيحة. نسبة التصافي اختلفت معنويا بين المجاميع و كانت مجموعة الكنترول أعلى من بقية المجاميع فى نسبة التصافي.

أوضحت التحاليل الطبيعية للضلوع ٩، ١٠ و ١١ أن أعلى نسبة للدهن سجلت فى مجموعة الكنترول في حين كانت مجموعة الكنترول أقل من الجموعة الرابعة فى نسبة اللحم. فى حين أوضحت التحاليل الكيماوية للحم ان هناك إختلافات معنوية بين المجاميع فى نسبة مستخلص الأثير و البروتين الخام و كذلك نسبة الرماد و كانت المجموعة الثانية أعلى المجاميع فى نسبة مستخلص الأثير و أقل المجاميع فى نسبة البروتين الخام. أدت المعاملة إلى زيادة الروتين الكلي والألبيومين وكذلك الجلوبيولين فى الدم فى حين لم يتأثر نشاط كل من إنزيمات الكبد والكرياتينين.

يستخلص من هذه الدراسة انه من الممكن إحلال بروتين تبن القمح المعامل بيولوجيا بنسب ٢٥ و ٥٠٪ من بروتين العلف المركز فى علائق الحملان فى ظل الزيادة الكبيرة فى أسعار العلف المركز وذلك دون حدوث اى تاثيرات سلبية على الأداء الانتاجى وصحة الحملان.