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EFFECT OF FEEDING BIOLOGICALLY TREATED WHEAT STRAW ON PRODUCTION PERFORMANCE OF SHEEP

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ABSTRACT: *Agaricus bisporus* (edible mushroom) was cultivated on wheat straw. Spent wheat straw (SWS) was obtained after harvesting the mushroom and offered to sheep *ad-lib* with two different levels of concentrate feed mixture (CFM) as tested rations in comparison with the conventional ration. Three experimental rations were tested through three digestibility trials and during a feeding trial lasted for 154 days. The experimental rations were, 50% of the nutritional requirements of sheep from concentrate feed mixture (CFM) + berseem hay *ad-lib.* (control), 50% of the nutritional requirements of sheep from CFM + SWS *ad-lib.* (T_1) and 25% of the nutritional requirements of sheep from CFM+ SWS *ad-lib.* (T_2)

The results showed that voluntary dry matter intake as g/h/d was not affected by feeding rations containing SWS (T_1 and T_2) in comparison with control. Digestibilities of all nutrients in T_1 were not significantly differed compared with those of the control one, except CF digestibility which significantly ($P \leq 0.001$) decreased in T_1. While, there were a significant decrease of all nutrients digestibility in T_2 as compared with those in control and T_1. The nutritive value as TDN and DCP in control was significantly ($P<0.001$) higher than those of T_1 and T_2. Feeding T_1 ration caused a slight increase in daily dry matter intake, live body weight, daily body gain compared with those of the control. The best feed conversion ratio as (kg DM / kg gain) obtained with T_1 followed by the control and finally T_2. Furthermore, the highest profit margin was recorded with T_1, while the lowest was observed with the control. Plasma total protein, albumin, globulin, A/G ratio, GOT, GPT, glucose and creatinine were not significantly affected by feeding SWS in T_1 and T_2, while urea-N values were significantly, ($P \leq 0.01$) increased with the rations containing SWS, but

these values were laying within the normal range. Dressing and prime cuts percentages were improved with rations containing SWS compared with the traditional ration (control). In general, these results indicate that using SWS to cover 50% of fattening lamb requirements as in T_1 ration could improve the productive performance of sheep without any adverse effects on their health.

INTRODUCTION

In Egypt, there is an urgent need to improve the feeding value of low quality roughage through various treatments in order to increase their utilization in ruminants feeding to cover the wide gap in animal feed requirements. Cultivation of white rot fungi on straws is an alternative to chemical and physical treatments for enhancing the straw quality as feed (Zadrazil and Brunnert, 1981).

Spent wheat straw which discarded after mushroom cultivation can be used as a feed ingredient in ruminant diets (Langar *et al.*, 1982; Bakshi and Langar, 1985 and Kakkar and Dhanda, 1998). The present work was designed to evaluate effect of incorporating the biologically treated wheat straw in sheep rations on digestibility, nutritive value, growth performance, feed conversion, some blood parameters and carcass traits.

MATERIALS AND METHODS

The present study was conducted at Department of Animal Production, Faculty of Agriculture, Zagazig University. The experimental work was carried out at El-Gemmeiza Experimental Station, Animal Production Research Institute , Ministry of Agriculture, Egypt from May till October , 2001.

Each ton of wheat straw was composted with 850 kg of broilers litter (3% N) , 60 kg of gypsum, 7kg of urea (46%N) and 7kg of soybean meal (7% N). Then, *Agaricus bisporus* (edible mushroom) was cultivated on the compost. Spent wheat straw (SWS) was obtained after the mushroom harvesting, dried by solarization and offered to animals *ad-lib* with two different levels of concentrate feed mixture (CFM) as tested rations in comparison with the control one.

Three digestibility trial were carried out using 3 mature crossbred (Suffolk x Ossimi) rams in each trial to evaluate the nutrients digestibity and the nutritive values of the tested rations which were:

Control ration (C): 50% of the nutritional requirement of rams from CFM+ berseem hay *ad-lib*.

1st tested ration (T_1): 50% of the nutritional requirement of rams from CFM + SWS *ad-lib.*

2nd tested ration (T_2) : 25% of the nutritional requirement of rams from CFM + SWS *ad-lib.*

Rams were fed the tested rations individually into metabolism cages. The nutritional requirements of rams were calculated according to NRC (1986) . Water was available all times for animals. Each trial lasted for 21 days as a preliminary period , followed by 7 days as a collection period. Daily consumed feed (g) and faeces out put (g) were recorded for each ram. Representative samples (10%) of faeces were dried at 60°C for constant weight. At the end of the collection period, the dried faeces samples were ground and stored until chemical analysis.

Fifteen growing crossbred (Suffolk x Ossimi) weaned male lambs aged 8 weeks (average initial BW, 17.27 kg) were randomly assigned to three experimental groups (5 lambs / each to test the previous experimental rations in a feeding trial lasted for 154 days. The calculated chemical composition of the consumed experimental rations is shown in Table (1). Lambs were kept under the same managerial and hygienic conditions. Fresh water was offered in free amounts.

Lambs were fed according to NRC (1986). The requirements of lambs were calculated biweekly according to the live body weight. Individual body weights of lambs (fasted) were recorded fortnightly. Daily body weight gain and feed conversion (kg DM/kg gain) were also accounted.

At the end of the feeding trial, three lambs of each group were sampled in the morning before feeding. Blood samples were taken via the jugular vein into heparinized tubes. Blood plasma was separated by centrifugation at 4000 r.p.m for 20 minutes. Plasma was analysed for total protein , albumin, glotamic- oxaloacetate transaminase (GOT) , glotamic – pyruvate transminase (GPT), urea-N, creatinine and glucose by using commercial kits purchased from Egyptian-American Company for Laboratory Services, Egypt. The routine chemical analysis for samples of feeds and faeces was carried out according to A. O. A. C. (1990). Chemical composition of feeds is shown in Table (2).

At the end of the experiment, three lambs of each group were randomly taken for slaughtering after being fasted for 16 hours. After slaughtering and complete bleeding, the slaughtered lambs were skinned and dressed out to study the carcass and its components. The economical evaluation was done by subtracting the feed cost /kg weight gain from the return/ kg weight gain.

The obtained data of live body weight, body weight gain, nutrients digestibility and blood parameters were statistically analyzed by using

analysis of variance (Snedecor and Cochran, 1982) according the followed model:

$$Yij = \mu + Ti + eij$$

Where, μ= the overall mean, Ti= the fixed effect of i^{th} ration (i=1, ..., 3) and eij– random error.

Differences in mean values between treatments were compared by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

1. Digestibility trial

1.1. Feed intake

Data obtained in Table (3) cleared that the voluntary DM intake as g/h/d did not significantly affected by feeding *Agaricus bisporus* SWS in T_1 and T_2 rations compared with the control ration. The highest value of DM intake was in T_1, while the lowest value was in T_2. These results may be due to that feeding SWS in T_1 ration (50% CFM + SWS *ad-lib.*) made it more acceptable and platable than the control ration. Similar trend was obtained by Chandra *et al.* (1991).

1.2. Nutrients digestibility

The results in Table (3) revealed that there were no significant differences between T_1 and the control in all nutrients digestibility,except CF digestibility which was significantly (P<0.001) higher in the control than that in T_1. On the other hand, digestibility of all nutrients in T_2 were significantly lower than those in T_1 and the control. The lower nutrients digestibility of T_2 ration (25% CFM + SWS *ad-lib.*) might be due to the higher consumption of SWS which contain high levels of total and acid insoluble ash. While, the lower digestibilities of CF in T_1 and T_2 may be attributed to its higher content of lignin. The nutrients digestibility values for rations containing SWS (T_1 and T_2) were higher than those recorded by Chandra *et al.* (1991) who incorporated the fungal treated rice straw at 50% level in rams rations.

1.3. Nutritive values

The nutritive values of the control ration as TDN and DCP (Table 3) were significantly (P<0.001) higher than those of rations containing SWS (T_1 and T_2). The highest nutritive values were obtained with in the control followed by those of T_1 and finally in T_2 ration. The lower values of TDN and DCP of T_1 and T_2 reflected the reduction of all nutrients digestibilities which might be due to the higher content of lignin and total and acid insoluble ash in SWS. Bakshi and Langar (1991), Chandra *et al.* (1991) and Bader (1993) obtained similar trends.

2. Feeding trial

2.1.Live body weight, body weight gain, feed intake and feed conversion

The obtained results in Table (4) showed that lambs fed T_1 ration (50% CFM + SWS *ad-lib.*) recorded slight improvements in the daily DM intake , live body

weight, daily body weight gain and feed conversion as (kg DM/ kg gain) compared with lambs fed the control ration during the whole experimental period (154 days) . The best values of the previous items during the whole feeding period obtained with T_1 followed by the control, then T_2. Live body weight and daily body weight gain values in T_2 were significantly ($P \leq 0.05$) lower than those of T_1 and the control through the whole feeding period (154 days), but there was an improvement in the daily body gain in T_2 during the second part of the feeding period (71-154 days) .

This finding cleared that there was a decline in DM intake, body weight gain and feed conversion ratio with decreasing CFM level in the ration less than that in T_1 ration.

2.2. Economical efficiency

Data obtained in Table (4) indicated that lambs fed T_1 ration (50% CFM + SWS *ad-lib.*) scored the highest total margin / head during the feeding period (154 days) followed by those fed T_2 ration (25% CFM + SWS *ad-lib.*) and finally those fed the control ration. In other words, when considering the total margin / head value in the control as 100 % , the total margin/ head values in T_1 and T_2 were 126.46 and 110.56%, respectively. The low price of SWS caused the lower feed cost / kg weight gain which reflected on the profit margin.

2.3. Blood parameters

Results in Table (5) cleared that concentrations of plasma total protein, albumin, globulin, A/G ratio and creatinine did not significantly affected by feeding SWS in T_1 and T_2 compared with the control one as reported by Bader (1993) and Kholif (2001). Also, plasma glucose concentration was not significantly differed among all treatments as observed by Kholif (2001). In the same manner concentrations of plasma GOT and GPT did not show any significant differences among the treatments as mentioned by Bader (1993). While, the concentrations of plasma urea-N were significantly ($P<0.01$) increased with rations containing SWS compared with the control one as noticed by Khorshed (2000), but these concentrations were laying within the normal range [10-50 mg/dl (Kaneko, 1989)].

2.4. Carcass traits

Dressing percentages on basis of live body weight, as well as fasted body weight and empty body weight (Table 6) were slightly higher for lambs fed rations containing SWS (T_1 and T_2) than those fed the control ration. Lambs fed T_1 ration (50% CFM +SWS *ad-lib.*) recorded the highest dressing and prime cuts percentages. Similar trend was observed by Henics (1987).

In conclusion, using SWS in sheep feeding to cover 50% of fattening lamb requirements and to replace berseem hay could be recommended in sheep feeding without any adverse effects on their health.

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Table (1): The calculated chemical composition of the consumed experimental rations (on DM basis).

Items	Control	T1	T2
Chemical composition%	50%CFM+BH *ad-lib.*	50%CFM+SWS *ad-lib.*	25%CFM+SWS *ad-lib.*
DM	89.00	89.28	89.46
OM	88.77	78.64	71.93
CP	15.49	14.40	13.48
CF	19.92	12.31	11.98
EE	3.45	3.27	2.47
NFE	49.91	48.66	44.00
Ash	11.23	21.36	28.07

CFM= concentrate feed mixture, SWS= spent wheat straw, BH= berseem hay

Table (2): Chemical composition of concentrate feed mixture spent wheat straw and berseem hay (% on DM basis)

Items	Concentrate feed mixture	Spent wheat straw	Berseem hay
Chemical composition (%)			
DM	88.91	89.66	89.09
OM	93.51	64.08	83.91
CP	16.44	12.40	14.74
CF	13.04	11.59	26.92
EE	3.50	1.55	1.83
NFE	60.53	38.54	40.42
Ash	6.49	35.92	16.09

The Concentrate feed mixture consisted of 35% wheat bran, 30% yellow corn, 15% undecorticated cotton seed meal, 15% sun flower seed meal, 3% molasses, 1.5% limestone and 0.5% salt.

Table (3): Voluntary dry matter intake, digestibility coefficients and nutritive values (Means ± SE) of the experimental rations.

Item	Control	T1	T2	Sig.
	50%CFM+ BH *ad-lib.*	50%CFM+ SWS *ad-lib.*	25%CFM+ SWS *ad-lib.*	
Dry matter intake: g/h/d	1700.59±50.65	1754.86±21.05	1644.26±41.25	NS
Digestibility coefficients%:				
DM	72.40±0.69 ^{a}	72.43±1.42 ^{a}	67.94±0.75 ^{b}	*
OM	75.63±0.66 ^{a}	72.19±1.42 ^{a}	64.16±0.82 ^{b}	***
CP	74.17±0.74 ^{a}	70.89±0.94 ^{a}	65.67±1.36 ^{b}	**
CF	69.39±0.95 ^{a}	55.95±2.79 ^{b}	44.01±0.44 ^{c}	***
EE	84.28±0.66 ^{a}	80.43±1.87 ^{a}	73.81±1.02 ^{b}	**
NFE	78.02±0.51 ^{a}	76.13±1.46 ^{a}	68.64±1.07 ^{b}	**
Nutritive value (%):				
DCP	11.57±0.12 ^{a}	10.20±0.13 ^{b}	8.85±0.18 ^{c}	***
TDN	70.86±0.55 ^{a}	60.05±1.01 ^{b}	48.43±0.51 ^{c}	***

NS = not significant, * ($P \leq 0.05$), ** ($P \leq 0.01$), *** ($P \leq 0.001$), Means in the same row with the same litters are not significantly different .

Table (4): Growth performance, dry matter intake feed conversion, feed cost, return and margin of body gain for crossbred lambs (Suffolk x Ossimi) fed rations containing spent wheat straw.

Item	Control	T1	T2	Sig.
	50%CFM+ BH *ad-lib.*	50%CFM+ SWS *ad-lib.*	25%CFM+ SWS *ad-lib.*	
Live body weight (kg)				
Initial weight	17.40±0.87	17.20±0.74	17.20±0.80	NS
After 70 days	29.40±1.91 [a]	31.60±1.44 [a]	23.60±1.33 [b]	**
Final weight (154 days)	45.00±2.10 [a]	45.80±1.88 [a]	39.40±1.25 [b]	*
Average daily body gain (kg):				
1-70 days	0.17±0.03 [a]	0.21±0.02 [a]	0.10±0.02 [b]	**
71-154 days	0.19±0.01	0.17±0.01	0.19±0.01	NS
1-154 days	0.18±0.01 [a]	0.19±0.01 [a]	0.14±0.01 [b]	*
Average DM intake (kg/h/d) •:	1.328	1.336	1.217	
Feed conversion (kg DM/kg gain)•:	7.38	7.03	8.69	
Feed cost/kg weight gain (L.E)	4.10	2.80	1.89	
Return/kg weight gain (L.E)••	10.00	10.00	10.00	
Margin/kg weight gain (L.E)	5.90	7.20	8.11	
Total margin/ head (L.E)	162.84	205.92	180.04	

NS = not significant, * ($P \leq 0.05$), ** ($P \leq 0.01$), Means in the same row with the same litters are not significantly different.

Costs of daily feed consumption (P.T) of the experimental rations were 73.46, 52.12 and 27.28 for control, T_1 and T_2, respectively.

• = Group feeding: lambs were fed in groups (5 lambs / each).

•• = Selling price of one kg live body weight.

Table (5): Blood plasma parameters (Means ± SE) of crossbred lambs (Suffolk x Ossimi) fed rations containing spent wheat straw.

Item	Control	T1	T2	Sig.
	50%CFM+ BH *ad-lib.*	50%CFM+ SWS *ad-lib.*	25%CFM+ SWS *ad-lib.*	
Total protein (g/dl)[1]	7.50±0.47	7.22±0.34	7.13±0.03	NS
Albumin (g/dl)[2]	3.56±0.33	4.15±0.19	3.72±0.19	NS
Globulins (g/dl)[3]	3.93±0.17	3.07±0.51	3.41±0.017	NS
A/G ratio[4]	0.90±0.07	1.47±0.035	1.10±0.011	NS
GOT (u/l)	37.00±16.56	27.00±5.13	22.00±2.65	NS
GPT (u/l)	5.67±2.19	3.33±0.33	3.67±0.67	NS
Urea-N (mg/dl)	31.71±2.82^{c}	38.23±0.85^{b}	45.73±0.45^{a}	**
Creatinine(mg/dl)	0.79±0.13	0.96±0.12	1.00±0.06	NS
Glucose (mg/dl)	59.77±4.82	89.24±0.91	69.40±13.76	NS

NS = not significant, ** ($P \leq 0.01$), Means in the same row with the same litters are not significantly different.

3 = 1 - 2, while 4 = 2 / 3.

Table (6): Dressing % and prime cuts% (percentages from the actual carcass weight) of crossbred lambs (Suffolk x Ossimi) fed rations containing spent wheat straw.

Item	Control	T1	T2
	50%CFM+ BH *ad-lib.*	50%CFM+ SWS *ad-lib.*	25%CFM+ SWS *ad-lib.*
Dressing % (1)	52.07	54.00	52.56
Dressing % (2)	58.24	60.88	60.17
Neck %	8.72	6.36	9.05
Shoulder %	18.86	19.40	19.16
Rack %	22.31	23.91	22.96
Loin %	7.28	7.47	7.13
Brisket %	3.81	3.58	4.40
Legs %	33.08	31.56	30.51
Flank %	5.94	7.72	6.79
Prime cuts % (3)	85.34	85.92	84.16

(1) Dressing % = Carcass weight / Fasted live body weight x 100.

(2) Dressing % = Carcass weight / Empty live body weight x 100.

(3) Prime cuts% = Shoulder % + Rack % + Loin % + Brisket% + Legs %.

تأثير التغذية على تبن قمح معامل بيولوجياً على الأداء الإنتاجى للأغنام

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تمت تنمية فطر عيش الغراب (المأكول) *Agaricus bisporus* على تبن القمح، وبعد الانتهاء من حصاد ثمار عيش الغراب تم تقديم تبن القمح الذى نمى عليه الفطر للشبع مع مستويين مختلفيين من العلف المركز كعليقتين تجريبيتين مقارنة بالعليقة التقليدية للأغنام، وقد اختبرت ثلاث علائق تجريبية من خلال ثلاث تجارب هضم وكذلك خلال تجربة نمو استمرت لمدة ١٥٤ يوماً، وكانت العلائق التجريبية كالآتى :

الكنترول (عليقة المقارنة) : ٥٠ % من الإحتياجات الغذائية للأغنام من العلف المركز + دريس البرسيم للشبع .

عليقة المعاملة الأولى : ٥٠% من الإحتياجات الغذائية للأغنام من العلف المركز + تبن القمح الذى نمى عليه الفطر للشبع.

عليقة المعاملة الثانية : ٢٥% من الإحتياجات الغذائية للأغنام من العلف المركز + تبن القمح الذى نمى عليه الفطر للشبع.

أوضحت نتائج تجارب الهضم أنه لم تتأثر كمية المادة الجافة المأكولة (جم / رأس / يوم) بمستوى تبن القمح الذى نمى عليه الفطر فى المعاملة االأولى و الثانية مقارنة بالمعاملة الكنترول، كما أنه لم تكن هناك فروقاً معنوية فى معاملات الهضم بين المعاملة الأولى والكنترول بإستثناء معامل هضم الألياف الخام الذى إنخفض معنويا (عند مستوى ٠,٠١ ر ٠) بينما كانت هناك فروقاً معنوية فى جميع معاملات هضم العناصر بين المعاملة الثانية وكلا من المعاملة الأولى والكنترول وقد كانت القيمة الغذائية كمركبات كلية مهضومة وكبروتين مهضوم للعليقة المقارنة (الكنترول) أعلى منها لكلاً من عليقة المعاملة الاولى وعليقة المعاملة الثانية (عند مستوى معنوية ٠,٠١ ر ٠)٠

إظهرت نتائج تجربة النمو أن التغذية على عليقة المعاملة الأولى (٥٠% علف مركز + تبن القمح الذى نمى عليه الفطر للشبع) قد أدت إلى زيادة طفيفة فى

المأكول يومياً من المادة الجافة ، الوزن الحى ، معدل النمو اليومى ، معدل التحويل الغذائى لحملان المعاملة الأولى مقارنة بحملان مجموعة المقارنة (الكنترول) ، كما تحقق أعلى هامش ربح فى المعاملة الأولى تليها المعاملة الثانية بينما كان أقل هامش ربح فى المعاملة المقارنة (الكنترول).

لم تظهر التغذية على تبن القمح الذى تمت تنمية الفطر عليه فى كل من المعاملة الأولى والمعاملة الثانية أى تأثير على تركيزات بلازما الدم لكل من الجلوكوز، البروتين الكلى ، الالبومين ، الجلوبيولين ، نسبة الألبيومين إلى الجلوبيولين ، انزيمات GOT و GPT ، الكرياتينين، فى حين أن تركيز نيتروجين اليوريا قد ارتفع معنوياً (عند مستوى ٠١ر٠) فى المعاملتين الأولى والثانية والتى أحتوت كلاً منها على تبن القمح الذى نمى علية الفطر مقارنة بالمعاملة المقارنة (الكنترول) ، الأ أن نيتروجين اليوريا فى الدم ظل داخل المعدل الطبيعى له.

ظهر هناك تحسن طفيف فى نسب التصافى والقطعيات الممتازة فى الذبيحة فى المعاملتين الأولى والثانية والتى تغذى فيه الحملان على تبن القمح الذى نمى عليه الفطر مقارنة بالمعاملة الكنترول والتى تغذت فيها الحملان على عليقة تقليدية.

تشير نتائج هذه الدراسة إلى أن استخدام تبن القمح الذى نمى عليه فطر عيش الغراب لتغطية ٥٠% من الإحتياجات الغذائية لتسمين الحملان كما فى المعاملة الأولى (٥٠% علف مركز + تبن القمح الذى نمى عليه الفطر للشبع) قد أدى إلى تحسن الأداء الإنتاجي للأغنام دون أية تأثيرات جانبية على صحتها.