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EVALUATION OF BIOLOGICAL TREATMENTS FOR AGRICULTURAL BY-PRODUCTS IN RUMINANTS FEEDING. III- GROWTH OF LAMBS

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ABSTRACT

Growth trial was conducted on twenty four Ossimi lambs, averaged 21.75 Kg live body weight and aged three months old. The lambs were assigned randomly to 6 similar groups of (4 lambs each) and housed in open pens. Lambs fed rations contained 60% of crude protein requirements according to NRC (1985) from concentrate feed mixture (CFM) plus untreated or fungal treated rice straw or corn stalks *ad. libitum*. The main results obtained confirmed that RS was more consumable and reflected lower levels of blood urea and creatinine and alkaline phosphates (ALP) activity. The fungus plus soybean meal treatment led to the highest final animal live body weight, growth rate, and feed consumption and the best feed conversion. It gave also the highest concentrations of blood total protein and globulin and the lowest activity of the enzymes AST, ALT and ALP. It was the best economically. Conclusively, the biological treatment with the white rot fungi, particularly with the fungus *Pleurotus ostreatus* of the field wastes (roughages) can improve their economical and save use to narrow the feeding gap as well as to protect the environment from their accumulation or burning them causing environmental pollution. So, fungal treatment of agricultural by-products can offer unconventional animal feed which is economical and environmentally friend without any negative effects on animal health.

Keywords: Fungal treatment, Lambs growth, Feed conversion.

INTRODUCTION

Non traditional feed resources such as crop residues and Agro-industrial by-products must searched in order to decrease the relay on traditional resources, to fill the gap and to decrease feeding costs (Zaza, 2005). Sugar beet plulp is a by-product remains after extraction of sugar from sugar beet tubers (Talha *et al.*, 2002). Approximately two thirds of the crop residues are burned or wasted, and hence lead to environmental pollution and consequently – health hazards. Utilization of such by-product can not only be used in favor of solving feed shortage problem but also as a method to control environmental pollution (Zaza, 2004). Feeding is the most important cost item for livestock production which represents about 70% of the total production costs (Borhami and Yacout, 2001). The major limitations of using these agricultural residues as feed are poor in nutrients such as protein content and vitamins and they are rich in fibers with low digestibility, or law palatability and high lignin contents. The degree of lignification is relatively more important in controlling hydrolysis rate in animal digestive tract

(Fan *et al.*, 1981). Therefore, there are many methods for improving the nutritive value of these by-products like as physical, chemical, physic-chemical and biological treatments. Biological treatment is used for increasing the nutritional value of many by-products, because they have significant concentrations of simple carbohydrates, such as mono-and disaccharides. For these reasons the microbial conversion of these wastes can improve their nutritional value and transforming them into animal feed with high quality (Villas-Boas *et al.*, 2002). Many efforts have been employed to remove the lignin and/or to break up the linkages between lignin and carbohydrates and to increase their feed values by biological treatments (El-Ashry *et al.*, 2001, 2002a & b, 2003, Mahrous, 2005; El-Shafie *et al.*, 2007 and Abo-Eid, 2008). The main objective of this research was to study the effect of fungal treatments of rice straw and corn stalks on feed intake, growth and feeding efficiency of Ossimi lambs.

MATERIALS AND METHODS

Animals and feeds:

Twenty four Ossimi lambs averaged 21.91 Kg live body weight (L.B.W) and aged three months old were assigned randomly to 6 similar groups (4 lambs/ each) and housed in open pens. Lambs were fed rations contained 60% of crude protein requirements according to NRC (1985) from concentrate feed mixture (CFM) plus untreated or fungal treated rice straw or corn stalks *ad. libitum*. The growth trials lasted 120 days. Fresh drinking water was available at all times the day. The body weight was individually recorded biweekly and feeding requirement of experimental lambs were changed every 2 weeks according to the body weight change as reported in NRC (1985) for sheep requirements. The following rations were offered to the 6 different groups:

- Groups 1 (RS)& 4 (CS): 60% of nutritional crude protein and energy requirements according to NRC (1985) from concentrate feed mixture (CFM) and untreated rice straw or corn stalks *ad libitum*, respectively.
- Groups 2 (RS) & 5 (CS) (T1): 60% of nutritional requirements from CFM and fungal (*Pleurotus ostreatus*) treated rice straw or corn stalks *ad libitum*, respectively.
- Groups (RS) 3 & 6 (CS) (T2): 60% of nutritional requirements from CFM and fungal (*Pleurotus ostreatus*) treated rice straw or corn stalks + 2.5 soybean meal *ad libitum*, respectively.

Treated rice straw and corn stalks were offered to lambs for 2 weeks as an adaptation period before the beginning of the growth trial. Feed intake, daily weight gain, and feed conversion (feed/gain) were calculated.

Economical efficiency:

Price of 1 ton of concentrate feed mixture (CFM) = 1500 LE. Price of 1 ton of untreated rice straw (roughage) = 100 LE. Price of 1 ton of rice straw treated with *P. ostreatus* = 200 LE (T1). Price of 1 ton of rice straw treated with *P. ostreatus* + 2.5 soybean = 250 LE (T2). Price of 1 ton of untreated corn stalks = 150 LE. Price of 1 ton of corn stalks T1 = 300 LE. Price of 1 ton of corn stalks T2 = 350 LE. Market price of 1 Kg live body weight in (2007) =

21 LE. Cost of roughage = Amount of rice straw or corn stalks (Kg) DM intake x price of rice straw or corn stalks. Cost of concentrate = Amount of concentrate dry matter intake (Kg) x price of conc. Average feed cost (LE/h/d) = Cost of roughage + cost of concentrate. Average revenue of daily gain (LE) = Price of 1 Kg live body weight x Average daily gain. Net feed revenue (LE) = Average revenue of daily gain – Average feed cost. Economic feed efficiency = Net feed revenue / average feed cost. The relative economic efficiency concerning the control group (untreated roughage) = 1

Statistical analysis:

The obtained data were analyzed according to Statistical Analysis System user's Guide (SAS, 1998) for one way analysis of variance. Separation among means were carried out by using Duncan's (1955) multiple range test.

RESULTS AND DISCUSSION

Significant differences were recorded between crop residual types in dry matter intake from roughages and total feed intake, in favor of RS. Also, significant differences were found among treatments in body weight and roughage and total feed intakes, in favor of T1 (Table 1). Obviously, all parameters were significantly increased by increasing the experimental intervals, from 10 – 12 to 26 – 28 weeks. The interaction effects among crop residual type, treatment, and time (experimental duration, i.e. intervals from 10 – 12 till 26 – 28 weeks), concerning body weight and feed intake of lambs fed CS and RS, respectively were significant.

Growth performance and feed utilization parameters by lambs as affected by the tested crop residual type and treatment are given in Table 2. There was no remarkable effect of type of crop residues on all parameters, except on roughage DM intake, which was higher ($P \leq 0.001$) for RS than CS. Final body weight, total gain, daily body gain, roughage DM intake as well as daily feed intake were all significantly higher and feed conversion was significantly better by the fungal treatments comparing with the control (untreated).

Blood biochemical parameters estimated at the end of the growth trial are shown in Table 3 as affected by either crop residual type or treatment comparing with the normal ranges. However, all values obtained from these tests are within the normal ranges. Wherever, crop residual type did not influence most of these parameters estimated, except concentration of urea and creatinine and activity of AST and alkaline phosphatase, which were higher ($P \leq 0.001$) for CS than for RS. The treatments significantly elevated either of total protein, globulin, and urea concentrations but significantly lowered the activity of AST, ALT and alkaline phosphatase.

The economic efficiency was calculated as the result of dividing the body weight gain price by the feed cost. No significant difference was found between CS and RS concerning economic efficiency. Yet, both fungal treatments (T1 and T2) significantly raised the economic efficiency, particularly (T2) comparing with the control (untreated), since T1 and T2 were better than the control by 59 and 83%, respectively (Table 4).

Table (1): Effect of crop residual type, treatment and times on average daily dry matter feed intake (g/head) fed by lambs (10 – 28 weeks) from the experimental diets (means ± SE).

Items	Crop residual type		Treatment			Times (weeks)								
	C.S	R.S	C	T_1	T_2	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28
Body weight (Kg)	34.94^{A} ± 1.121	34.88^{A} ± 1.108	32.21^{B} ± 1.233	36.10^{A} ± 1.357	36.42^{A} ± 1.448	21.92^{H} ± 1.080	25.25^{G} ± 201	28.42^{F} ± 1.339	31.46^{E} ± 1.490	34.63^{D} ± 1.638	37.96^{C} ± 1.801	41.33^{BC} ± 1.870	44.96^{AB} ± 1.944	48.25^{A} ± 2.022
Concentrate feed mixture (g) intake	686.85^{A} ± 5.253	696.83^{A} ± 4.990	692.93^{A} ± 7.024	692.08^{A} ± 5.555	690.51^{A} ± 6.285	640.92^{C} ± 1.345	665.92^{C} ± 1.154	692.21^{B} ± 1.067	710.21^{A} ± 0.949	714.13^{A} ± 0.857	710.96^{A} ± 0.824	704.46^{A} ± 0.803	697.25^{B} ± 0.834	690.54^{AB} ±1.063
Roughage dry matter intake (g)	657.45^{B} ± 1.520	710.82^{A} ± 1.752	558.61^{C} ± 1.999	771.58^{A} ± 1.425	722.33^{B} ± 1.715	503.21^{G} ± 3.443	576.67^{E} ±3.448	617.50^{E} ±3.086	662.92^{D} ± 3.195	699.58^{C} ± 2.864	732.58^{B} ± 3.024	758.54^{B} ± 2.683	790.21^{A} ± 2.270	816.04^{A} ± 2.212
Total feed intake (g)	1343.75^{B} ±1.787	1401.78^{A} ±2.070	1244.39^{C} ±2.469	1463.67^{A} ±1.695	1410.33^{B} ±2.145	1136.63^{H} ±4.374	1242.58^{G} ±4.284	1309.71^{F} ±3.892	1373.13^{E} ±3.892	1413.71^{D} ±3.292	1443.54^{B} ±3.281	1463.00^{A} ^{B}±2.809	1484.16^{A} ±2.072	1487.63^{A} ±2.728

C.S = Corn stalks R.S = Rice straw C = Untreated

T_1 = *Pleurotus ostreatus* T_2 = *Pleurotus ostreatus* + 2.5% soybean meal.

A, B, C, E, F and G: Means in the same row with different superscripts are significantly ($P \leq 0.05$) different.

Table (2): Effect of crop residual type and treatment fed to lambs on growth performance, feed intake and feed conversion (means + SE).

Items	Crop residual type		Treatment		
	Corn stalks	Rice straw	Untreated	T_1	T_2
Initial weight (Kg)	21.92^{A} + 1.756	21.92^{A} + 1.340	22.13^{A} + 1.255	21.88^{A} + 1.315	21.75^{A} + 1.161
Final weight (Kg)	48.33^{A} + 2.837	48.17^{A} + 3.007	42.75^{B} + 2.740	50.00^{A} + 2.006	52.00^{A} + 2.240
Total gain (Kg)	26.42^{A} + 1.579	26.25^{A} + 2.132	20.63^{B} + 1.851	28.13^{A} + 2.167	30.25^{A} + 1.082
Daily body gain (Kg)	0.219^{A} + 0.013	0.219^{A} + 0.018	0.172^{B} + 0.015	0.232^{A} + 0.018	0.25^{A} + 0.009
Concentrate feed mixture (Kg)	0.773^{A} + 0.009	0.784^{A} + 0.008	0.780^{A} + 0.016	0.779^{A} + 0.007	0.777^{A} + 0.008
Roughage dry matter intake (Kg)	0.745^{B} + 0.040	0.800^{A} + 0.047	0.628^{B} + 0.048	0.868^{A} + 0.034	0.820^{A} + 0.036
Daily feed intake (Kg)	1.512^{A} + 0.045	1.582^{A} + 0.051	1.407^{B} + 0.062	1.647^{A} + 0.037	1.587^{A} + 0.042
Feed conversion (Feed/ gain) Kg DM/Kg gain	7.044^{A} + 0.307	7.721^{A} + 0.580	8.496^{A} + 0.562	7.339^{AB} + 0.631	6.312^{B} + 0.094

A and B: Means in the same row with different superscripts are significantly ($P \leq 0.001$).

Table (3): Effect of crop residual type and treatment on some blood constituents (regardless to the other variable) at the end of the growth trial on lambs (means ± SE).

Items	Crop residual type		Treatment			Normal range*
	Corn stalks	Rice straw	Untreated	T_1	T_2	
Total protein, g/dl	$6.85^{A} \pm 0.128$	$6.76^{A} \pm 0.145$	$6.48^{B} \pm 0.053$	$6.93^{AB} \pm 0.183$	$7.01^{A} \pm 0.169$	6.30 - 8.40
Albumin, g/dl	$3.68^{A} \pm 0.084$	$3.70^{A} \pm 0.119$	$3.55^{A} \pm 0.038$	$3.69^{A} \pm 0.139$	$3.84^{A} \pm 0.153$	3.50 - 5.50
Globulin, g/dl	$3.17^{A} \pm 0.058$	$3.06^{A} \pm 0.051$	$2.93^{B} \pm 0.049$	$3.24^{A} \pm 0.050$	$3.18^{A} \pm 0.053$	2.38 - 5.34
A/G ratio	$1.16^{A} \pm 0.022$	$1.21^{A} \pm 0.037$	$1.22^{A} \pm 0.027$	$1.14^{A} \pm 0.030$	$1.21^{A} \pm 0.050$	
Urea, mg/dl	$28.10^{A} \pm 0.782$	$26.13^{B} \pm 0.748$	$24.29^{B} \pm 0.373$	$28.79^{A} \pm 0.536$	$28.23^{A} \pm 1.004$	10 – 50
Creatinine, mg/dl	$1.01^{A} \pm 0.010$	$0.96^{B} \pm 0.022$	$0.99^{A} \pm 0.032$	$0.98^{A} \pm 0.024$	$0.98^{A} \pm 0.009$	0.8 - 1.5
AST, u/l	$30.50^{A} \pm 0.862$	$26.30^{B} \pm 1.234$	$32.56^{A} \pm 0.499$	$25.13^{C} \pm 1.310$	$27.58^{B} \pm 1.053$	8 - 40
ALT, u/l	$16.65^{A} \pm 0.134$	$16.78^{A} \pm 0.258$	$17.34^{A} \pm 0.232$	$16.18^{B} \pm 0.163$	$16.63^{B} \pm 0.147$	5 - 30
Alkaline phosphatase, u/l	$23.43^{A} \pm 0.393$	$22.13^{B} \pm 0.245$	$23.24^{A} \pm 0.399$	$22.73^{B} \pm 0.498$	$22.36^{B} \pm 0.471$	9 - 35

*Kaneko (1989).

A, B and C: Means in the same row with different superscripts are significantly ($P \leq 0.01$) different.

Table (4): Effect of crop residual type and treatment on economical evaluation of the experimental diets for the growth of lambs (means ± SE).

Items	Crop residual type		Treatment		
	Corn stalks	Rice straw	Untreated	T_1	T_2
Initial weight (Kg)	$21.92^{A} \pm 1.756$	$21.92^{A} \pm 1.340$	$22.13^{A} \pm 1.226$	$21.88^{A} \pm 1.132$	$21.75^{A} \pm 0.216$
Final weight (Kg)	$48.33^{A} \pm 2.837$	$48.17^{A} \pm 3.007$	$42.75^{B} \pm 0.374$	$50.00^{A} \pm 0.301$	$52.00^{A} \pm 0.324$
Total gain (Kg)	$25.58^{A} \pm 1.427$	$26.25^{A} \pm 2.132$	$20.63^{B} \pm 1.851$	$28.13^{A} \pm 2.167$	$29.00^{A} \pm 1.180$
Daily body gain (Kg)	$0.219^{A} \pm 0.013$	$0.219^{A} \pm 0.018$	$0.172^{C} \pm 0.015$	$0.232^{B} \pm 0.018$	$0.252^{A} \pm 0.009$
Concentrate feed mixture intake (Kg)	$92.73^{C} \pm 0.372$	$94.07^{B} \pm 0.563$	$94.88^{A} \pm 0.456$	$93.50^{B} \pm 0.353$	$93.59^{B} \pm 0.412$
Roughage intake (Kg)	$88.76^{B} \pm 0.470$	$95.98^{A} \pm 0.567$	$75.41^{C} \pm 0.578$	$104.16^{A} \pm 0.414$	$97.53^{B} \pm 0.425$
Daily feed intake (kg)	$1.512^{A} \pm 0.045$	$1.582^{A} \pm 0.051$	$1.407^{B} \pm 0.062$	$1.647^{A} \pm 0.037$	$1.587^{A} \pm 0.042$
Feed conversion (feed/gain)	$7.000^{A} \pm 0.300$	$7.720^{A} \pm 0.579$	$8.496^{A} \pm 0.562$	$7.277^{AB} \pm 0.626$	$6.313^{B} \pm 0.093$
Total gain cost (L.E.)	$554.75^{A} \pm 0.331$	$551.25^{A} \pm 0.448$	$433.13^{C} \pm 0.389$	$590.63^{B} \pm 0.455$	$635.25^{A} \pm 0.227$
Total feed cost/lamb (L.E.)	$157.88^{B} \pm 0.322$	$162.86^{A} \pm 0.338$	$148.25^{B} \pm 0.336$	$166.19^{A} \pm 0.184$	$166.67^{A} \pm 0.280$
Net revenue lamb (L.E.)	$396.87^{A} \pm 0.306$	$388.40^{A} \pm 0.419$	$284.88^{B} \pm 0.369$	$424.44^{A} \pm 0.441$	$468.58^{A} \pm 0.204$
Economic efficiency (EE)	$3.31^{A} \pm 0.256$	$3.24^{A} \pm 0.349$	$2.374^{B} \pm 0.309$	$3.538^{A} \pm 0.368$	$3.904^{A} \pm 0.171$
Relative EE to control	$1.38^{A} \pm 0.135$	$1.57^{A} \pm 0.195$	$1.00^{B} \pm 0.001$	$1.59^{A} \pm 0.186$	$1.83^{A} \pm 0.225$

A, B and C: Means in the same row with different superscripts are significantly ($P \leq 0.01$) different

The interaction effect revealed the superiority of T2 and T1, respectively than the control in both crop residual types.

Although, all values obtained herein for blood biochemical parameters were within the normal ranges according to Kaneko (1989), biological treatment of agricultural by-products may cause no significant effect on blood parameters (Deraz and Ismail, 2001; Bassuny *et al.*, 2005 and Abdelhamid *et al.*, 2006 & 2007) and did not cause any abnormal conditions in liver and kidney functions (El-Ashry *et al.*, 2001 and Abdelhamid *et al.*, 2006). But it may also alter (positively or negatively) these metabolites (Abd El-Aziz and Ismail, 2001; El-Sayed *et al.*, 2002; Bassuny *et al.*, 2003 b Marghany *et al.*, 2004 and Kholif *et al.*, 2005).

Growth and feed conversion as well as economic efficiency were all significantly affected by type of roughage and treatment besides intervals of the study period. Also, Marghany *et al.* (2004) and Abdelhamid *et al.* (2007) gave better daily body weight gain and Marghany *et al.* (2004) and Mohamed (2005) reported better feed conversion by feeding the biological fermented roughages.

Biological treatment reduced the feed cost by 16.82% (Deraz, 1996) to about 36% (Belewu and Ademilola, 2002). However, biological treatments yielded the best economic efficiency (Marghany *et al.*, 2004 and Hamza *et al.*, 2006).

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تقييم المعاملات البيولوجية للمخلفات الزراعية فى تغذية المجترات: ٣ – نمو الحملان

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أجريت هذه الدراسة على أربعة وعشرين حمل أوسيمى نامى، عمرها عشرة أسابيع بمتوسط وزن ٢١,٧٥ كجم، قسمت إلى ستة مجاميع، كل مجموعة أربع حملان، واستمرت التجربة لمدة ١٢٠ يوماً، وذلك لدراسة معدل استهلاك الغذاء من المادة الجافة فى اليوم، معدل النمو اليومى، معدل التحويل الغذائى، وقياسات الدم للحملان، والتكلفة الاقتصادية للتغذية على المخلفات الزراعية المعاملة بيولوجيا. وكانت أهم النتائج أنه لم يكن لنوع المخلف تأثير معنوى على استهلاك الغذاء من المادة الجافة، سواء من العلف ا لمركز أو المخلفات المستعملة، سواء كانت معاملة أو غير معاملة، وكان أعلاها مع قش الأرز مقارنة مع حطب الذرة. لم يكن هناك فروق معنوية لأثر المعاملات المختلفة على استهلاك المادة الجافة، وكان أعلاها مع المعاملة الأولى مقارنة بالمعاملة الثانية والكنترول. سجلت فروق معنوية مع زيادة وقت التغذية، وكان أقصاها فى الفترات الأسبوعية ٢٢ – ٢٤، ٢٤ – ٢٦ حيث تم استهلاك أكبر كمية من المادة الجافة فى اليوم. سجلت فروق معنوية جداً، ويزداد استهلاك المادة الجافة بزيادة مدة التسمين، وسجلت أعلى استهلاك فى المادة الجافة المستهلكة فى قش الأرز غير المعامل فى الوزنة قبل الأخيرة، وفى المعاملة الأولى فى الوزنة السابعة، وفى المعاملة الثانية فى الوزنة الأخيرة مقارنة بحطب الذرة. هناك فروق معنوية جداً بين المعاملات، وكان أعلى معدل نمو يومى مع المعاملة الثانية، وأقل نسبة تحويل. أعطت المعاملات فروق معنوية جداً، وكانت أعلى نسبة نمو مع المعاملة الثانية لحطب الذرة، وأقل معدل تحويل مقارنة بالمعاملة الأولى والثانية لقش الأرز. معدل النمو اليومى سجل أعلى قيمه (٢٥٢ جم/يوم) للأغنام المغذاة على العليقة (المعاملة الثانية لحطب الذرة) المعامل بيولوجيا مع إضافة ٢,٥% كسب فول صويا، وكانت هذه القيمه معنوية مقارنة مع المعاملة الأولى لحطب ا لذرة (٢٢٧ جم/يوم) والكنترول (١٧٧ جم/يوم) مقارنة مع قش الأرز المعامل بالمعاملة الأولى (٢٣٨ جم/يوم)، والمعاملة الثانية (٢٥٢ جم/يوم)، والكنترول (١٦٧ جم/يوم)، وكان أعلى استهلاك مادة جافة فى اليوم مع المعاملة الأولى لقش الأرز. العائد من التسمين حقق أعلى قيمه مع المعاملة الثانية لحطب الذرة، وبلغت ٤٧١,٧٩ جنية، وأقل عائد من التسمين كان مع قش الأرز غير المعامل وبلغ ٢٦٩,٩٥ جنية مقارنة بالمعاملة الأولى لحطب الذرة والمعاملة الأولى والثانية لقش الأرز. ونلاحظ أن المعاملة البيولوجية قللت العلف المركز المستخدم وأيضا قللت تكلفة كيلو اللحم.

والخلاصة أن المعاملة البيولوجية تعمل على خفض تكلفة إنتاج ١ كجم من اللحم (النمو)، وذلك من خلال خفض تكاليف التغذي، وعلى ذلك ينصح بتقديم المخلفات المعاملة بيولوجيا مع ٦٠% من العلف المركز للمجترات، فهى آمنة.