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Effect of feeding biological treated rice straw on carcass characteristics and rabbits meat composition

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Abstract : The aim of this work was study the effect of feeding biological treated rice straw with *Pleuratus ostreatus* at different levels on carcass characteristics and meat composition of rabbits.Dried treated rice straw was used to formulate the experimental pelleted diets by substituting of berseem hay with treated rice straw with medium only (without *Pleurotus ostreatus*)and biological treated rice straw with *Pleurotus ostreatus* at different levels,all diets were formulated to be aiso-nitrogenous and iso-caloric, and to meet the nutrients requirements for growing rabbits.A number of 42 weaned New-Zealand white rabbits about 6 weeks of age and weighted 500 g in average were randomly divided into 7 groups, 6 rabbits in each. The experimental groups were fed as following; the first group fed control diet (0% rice straw) and the other six groups were fed on diets containing either rice straw without *Pleuratus ostreatus*(medium only) or biological treated rice straw with *Pleuratus ostreatus* at 33, 66 and 100% as replacing of berseem hay (11, 22 and 33% of total diet). The experiment lasted for 91 days, at the end of the experimental period three rabbits from each group were slaughtered to evalute carcass characteristics and meat composition. The results showed that either treatments or levels had no significant effect on EBW, CW1, CW2, DP1, DP2, DP3, carcass cuts. Also no significant effect on total external offals included (blood, fun, tail and ears), except legs which significantly differed ($P \leq 0.05$) between treatments levels. No significant effect on total edible offals between treatments, however, liver and heart values were significantly ($P \leq 0.05$) higher for rabbits fed with *P.*ostreatus than those fed without *P.ostreatus*. Also, total edible offals, liver and heart values were ($P \leq 0.05$) increased with increasing level of rice straw and the highest value was recorded with level of 100%. The results of interaction showed that dietary treatments and levels had no significant effect ($P \geq 0.05$) on EBW, CW1 and CW2. Also, no significant effect of interaction between treatments and levels on DP1, DP2 and DP3for without *P.ostreatus* and with *P.ostreatus* groups, except with level of 66% with *P.ostreatus* and 100% without *P.ostreatus*. Middle part of carcass, liver and total edible offals were ($P \leq 0.05$) higher with 33%with *P.ostreatus*. External offals were no significant differ, except with level of 66% without *P.ostreatus*. The results showed that there are no significant differences among different levels on chemical composition of carcass meat. Concerning of the DM and ash content, there were no significant differences between treatments. While, incorporating of biological treated rice straw with *P.ostreatus* significantly ($P \leq 0.05$) decreased protein content (60.30%) in carcass compared to those fed without *P.ostreatus* (64.69%), in contrast, EE was significant higher (37.06%) for groups fed with *P.ostreatus* than (32.72%) for those fed without *P.ostreatus*. Effect of interaction between treatments and levels on DM and ash content were no significant for all experimental groups. While, rabbits fed with *P.ostreatus* at 66% had ($P \leq 0.05$) lower CP content than those fed without *P.ostreatus*. But, EE content was ($P \leq 0.05$) increased with 66% biological treated rice straw with *P.ostreatus* compared with those fed without *P.ostreatus.*

Key words: Rice straw, biological treatment, *Pleuratus ostreatus,* carcass characteristics and rabbits.

Introduction

In the developing countries, such as Egypt, animals suffer from shortage of feeds and, also,are continuously increasing in the costs. However, many thousand tons of agricultural residues are producing from fields and processing of fruits and vegetablesper year. In Egypt there are about 25 million tons of agricultural by–products produced annually[1]. Such low quality roughages (rice straw and corn stalks) are high in lignocellulytic materials and are generally low in readily available carbohydrates as well as nitrogen and certain minerals. Also their utilization is limited as a reason of low voluntary intake by the animals and high transportation cost, being bulky[2,3].

A great deal of research work was done to full use of thisby–products andincreasing their feeding value. Intake and utilization of low quality roughages could be increased by supplementation with some nutrients or by applying some treatments,such as; physical, chemical and biological methods[4,5]. Among these methods, biological treatments were shown to be the most effective method[6,7,8].

Feeding biological treated agricultural by-products did not significant effect on dressing percentage for rabbits [7,8], while [9] stated that feeding rabbits on biological treated sugar beet pulp significant increased dressing percentage. Chemical composition for rabbits meat was affected by feeding biological treated rice straw and sugar beet pulp [7,8,9]**.** Rabbit meat can contribute to solve the meat shortage problem in most developing countries, because, rabbits have rapid growth rate, high fertility, short gestation period, short generation intervals, high feed efficiency,early marketing age, high muscle bone ratio, also, meat of rabbits has high protein content, low content of fat and cholesterol[10].

The aim of thiswork wasstudy the effect of feeding biological treated rice straw with *Pleuratus ostreatus*on carcass characteristics and meat composition of rabbits.

Materials and Methods

Microorganism:

The spawn of the mushroom (*Pleurotus ostreatus*) mycelia grown on sorgm grains was purchased from Mushroom Production Unit, Agricultural Microbiology Department, National Research Centre, Dokki, Giza, Egypt.

Biological treatment for rice straw:

Rice straw was chopped into small pieces of 2-3 cm length, moistened and cleanedby water. Clean 50x100 cm polyethylene bags was filled with 8 kg rice straw, tied up and autoclaved at 121°C for 1 hr. The sterilized rice straw was divided to two parts (80 kg each); the first part was moistened with sterilizedmedium contained, 2.5% molasses, 2.5% urea, 1.5% ammonium sulphate, 1.0% supper phosphate and 0.5% magnesium sulphate at solid: liquid (1:2) (without *Pleurotus ostreatus*). The second part of rice straw was moistened with the above medium and spawnedwith 8% (w/w) of mushroom inoculants using the lamp spawning method [11]. The bags were placed in a spawn running room at 25±2°Cin dark room. After completion of spawn running, the bags were transferred to growth chamber, kept at 24 °C and 80-90% relative humidity. The bags were unfolded at the upper parts and water was sprayed for maintaining the moisture level as fine mist by a nozzle. The treatment extended 21 day,at the end of this period, the *Pleurotus ostreatus* crop (mushroom) had bed harvested before the treated rice straw was collected and dried. The treated rice straw was collected and exposed to sun-dry until the moisture content reached less than 10%, then packed and stored until used in manufacturing the pelleted diets.

Experimental diets:

Dried treated rice straw wasused to formulate the experimental pelleted diets by substituting of berseem hay with treated rice straw with medium only (without *Pleurotus ostreatus*)and biological treated rice straw with *Pleurotus ostreatus* at levels of 33%, 66% and 100%(11, 22 and 33% of total diet) as presented in Tables (1).All the experimental diets were formulated to be a iso-nitrogenous and iso-caloric, and to meet the nutrient requirements of growing rabbits according to [12].

Table (1): Formulation and composition of the experimental diets.

Ingredients	Experimental diets						
	Control	**Without *Pleurotus ostreatus***			**With *Pleurotus ostreatus***		
	0%	33%	66%	100%	33%	66%	100%
Yellow corn	15.75	21.25	28.75	38.75	21.25	28.75	38.75
Barley	14.50	14.50	13.50	2.50	14.50	13.50	2.50
Soybean meal	17.40	18.40	19.65	20.65	18.00	19.65	20.65
Wheat bran	16.50	9.50	1.25	0.60	10.00	1.25	0.60
Berseem hay	33.00	22.00	11.00	-	22.00	11.00	-
Rice straw	-	11.00	22.00	33.00	11.00	22.00	33.00
Calcium Di-phos.	2.05	2.50	2.85	3.05	2.50	2.85	3.05
Lime stone	0.10	0.10	0.10	0.10	0.10	0.20	0.60
Na Cl	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Premix *	0.30	0.30	0.30	0.30	0.30	0.30	0.30
L.Methonine	0.04	0.05	0.10	0.15	0.04	0.10	0.15
*Calculated***							
Digestable energy	2513	2496	2491	2453	2493	2445	2444
Calcium	1.08	1.03	0.98	1.02	0.9	0.92	0.97
Phosphorus	0.80	0.82	0.79	0.80	0.85	0.80	0.82
Sodium	0.20	0.19	0.18	0.17	0.19	0.79	0.18
Lysine	0.89	0.83	0.77	0.72	0.86	0.4	0.71
Methonine	0.55	0.55	0.56	0.57	0.55	0.53	0.57

*:*Each kg of vitamines and minerals mixture contains; Vit.A 2.000-000 Iu, Vit. B, 0.33g, Vit* B_2 *1.09; Vit* B_3 *150 Iu , vit E 8.33 g , vit K 0.33 g, pantothenic acid, 3.33 g, nicatonic acid 30.00g, vit* B_6 *2.00 g, vit.* B_{12} *1.7 mg, folic acid 0.039, biotin 33 mg, Cu 0.50 g, cholin chloride 200 mg, Mn 5.0 g, Fe 12.5 g, Mg 66.7 mg, Co 1.33 mg, Se 16.6 mg, Zn 11.9, iodine 16.6 mg and antioxidant 10.0 g.*

**: According to [12].

Animals and feeding trials:

A number of 42 weaned New-Zealand white rabbits about 6 weeks of age and weighted 500 gin average were randomly divided into 7 groups,6 rabbits in each, each group divided into three replicates. All animals were kept under the same managerial and hygienic conditions and were housed in metal battery cages. Each replicate involved two rabbits and were housed separately in cages, provided with feed and water *ad-libitum* at 28°C ambient temperature in average with natural light and ventilation.The experimental groups were fed as following;the first group was fed control diet (0% rice straw) and the other six groups were fed on diets containing either rice straw without *Pleuratus ostreatus*(medium only) or biological treated rice straw with *Pleuratus ostreatus* at 33, 66 and 100% as replacing of berseem hay (11, 22 and 33%of total diet),the experimental lasted for 13 weeks (91 days).

Slaughter trials:

At the end of experimental period, rabbits were fasted for 12 hours, before sacrificing the animals were individually weight, then three rabbits from each group slaughtered by cutting the neck and jugular vein with a sharp knife to evaluate carcass characteristics and meat composition. When complete bleeding was achieved, the slaughtered weight was recorded, then shinning off was carried out. The skin, viscera, lung, liver, kidneys and heart were removed off, then rest of the body was weight to determine the dressing weight. The loss of blood viscera, lungs, skins, legs and tail were termed as the offal organs weight. Carcass cuts (fore part, middle part, hind part and head with neck).The cracass meat samples from9, 10 and 11th ribs dried at 60ºC for 24 hr. and kept for chemical analysis.

Analytical methods:

Samples of the carcass was analyzed to determine dry matter (DM), ether extract (EE). Crude protein

(CP) and ashaccording to[13].

Statistical analysis:

The collected data were subjected to statistical analysis as two factors-factorial analysis of variance using the general linear model procedure of [14]**.** Duncan's Multiple Range Testwas used to separate means when the dietary treatment effect was significant [15]. The statistical model was:

$$Y_{ijk} = \mu + Ti + L_j + (TL)_{ij} + e_{ijk}$$

Where;Y_{ijk}: Observation, μ: Overall mean, Ti: Effect of treatment, L_j: Effect of level, TL_{ij}: Interaction effect between the treatments and levels, and e_{ijk}: the experimental error.

Results and Discussion

Carcass characteristics:

The average values of empty body weight (EBW), carcass weight (CW1), carcass weight + total giblets (CW2), dressing percentage(DP1, DP2, DP3, carcass cuts ,external offals and edible offals (giblets)of experimental groups are presented in (Table 2). The results showed that either treatments or levels had no significant effect on EBW, CW1, CW2,DP1, DP2, DP3, carcass cuts. Also no significant effect on total external offals included (blood, fun, tail and ears), except legs which significantly differed ($P \leq 0.05$) between treatments and between levels, and the highest value (106.5 g) was recorded with66% and the lowest one (85.3 g) recorded for rabbits fed control diet.No significant effect on total edible offals between treatments, however, liver and heart values were significantly ($P \leq 0.05$) higher for rabbits fed with *P.ostreatus* than those fed without *P.ostreatus*. Also, total edible offals, liver and heart values were ($P \leq 0.05$) increased with increasing level of rice straw and the highest value was recorded with level of 100%.The interaction between treatments and levels on carcass characteristics is presented in Table (3). The results showed that dietary treatments and levels had no significant effect ($P \geq 0.05$) on EBW, CW1 and CW2. Also, no significant effect of interaction between treatments and levels on DP1, DP2 and DP3for without *P.ostreatus* and with *P.ostreatus* groups, except with level of 66% with *P.ostreatu s*and 100% without *P.ostreatus*. Middle part of carcass, liver and total edible offals were ($P \leq 0.05$) higher with 33%with *P.ostreatus*. External offals were no significant differ, except with level of 66% without *P.ostreatus*. These results agreement with [16] who reported that heart had a heavier weight for rabbits fed high fiber diets than those fed low fiber diets. The dressing percentage results are agreement with [17] reported that the dressing percentage for rabbitswere 60.6and 60.8% for New Zealand x California and California x New Zealand rabbits, respectively. [7]when fed NZW rabbits diet contained 0, 10, 20 and 30% biologically treated corn stalks with *Trichoderma viride* replaced berseem hay, reported that dressing percentage based on carcass weight ranged from 53.20 to 54.96%, and the dressing percentage value based on empty body weight ranged between 56.7 and 59.73% with no significant differences among treatments for both. Weights and percentages of different carcass cuts (forepart, middle part and hind part) did not influenced by dietary treatments.

Table (2):Effects of biological treatment and substituting levels of rice straw on carcass characteristics for rabbits.

Item	Treatments		SEM	Levels				SEM
	Without *P.ostreatus*	With *P.ostreatus*		0%	33%	66%	100%	
Empty body weight (EBW), g	2002	2207	77.72	2121	2014	2169	2117	77.72
Carcass wt. (CW1), g	1183	1332	50.12	1257	1210	1293	1269	50.12
Carcass wt. +total giblets (CW2), g	1292	1456	53.59	1357.7	1324	1414	1400	53.54
Dressing percentages (DP) %								
DP1	53.25	54.46	0.48	53.67	54.29	53.49	53.96	0.48
DP2	58.93	60.27	0.53	59.39	60.08	59.20	59.72	0.53
DP3	64.42	65.93	0.52	64.12	65.78	64.82	65.98	0.52
Carcass cuts, g								
Fore part	354	392	15.45	383	358	370	383	15.45
Middle part	237	274	12.65	228	294	271	274	12.65
Hind part	429	489	20.47	477	443	469	448	20.47
Head + Neck	162	177	5.01	168	161	184	165	5.01
Slaughter weight (SW),g	2216	2443	86.02	2348	2229	2401	2342	86.02
External offal's, g								
Blood	82.7	80.0	5.72	80.3	68.2	93.0	83.3	5.72
Fur	284	316	14.78	340	289	286	285	14.78
Legs	90.5^{b}	91.9^{a}	3.16	85.3^{b}	86.3^{b}	106.5^{a}	86.7^{b}	3.16
Tail	14.5	18.1	1.22	16.67	15.0	17.3	16.2	1.22
Ears	35.8	36.2	1.39	35.3	34.5	38.8	35.3	1.39
Total	507.5	542.2	22.08	557.5	493	541.6	506.5	22.0
Edible offal's (Giblets), g								
Kidneys	18.1	19.0	0.76	17.7	18.2	18.7	19.7	0.76
Liver	68.3^{b}	79.5^{a}	3.89	61.0^{b}	72.3^{ab}	74.7^{ab}	87.7^{a}	3.89
Heart	8.0^{b}	9.1^{a}	0.47	7.0^{b}	8.3^{b}	11.0^{a}	7.8^{b}	0.47
Lungs	13.9	15.1	0.76	14.0	14.5	15.3	14.2	0.76
Spleen	1.0	1.0	0.00	1.0	1.0	1.0	1.0	0.00
Total	109.3	123.7	5.00	100.7^{b}	114.3^{ab}	120.7^{ab}	130.4^{a}	5.00
Digestive tract, g								
Full	416	446	15.41	433	410	445	435	15.41
Empty	202	210	9.33	206	195	213	210	9.33
Content	214	236	8.85	227	215	232	225	8.85

a and b: Means within each treatment having different superscripts differ significantly ($P\leq0.05$).
SEM:Standard error of the mean.
Dp1: CW/ SW.DP2: CW/ EBW. DP3: CW+ total edible offals (giblets/ EBW).

Table (3):Interactions effect between treatments and levels of rice straw on carcass characteristics of rabbits.

Item	0% (control)	Without *Pleuratus ostreatus*			With *Pleuratus ostreatus*			SEM
		33%	66%	100%	33%	66%	100%	
Empty body wt.(EBW), g	2121	1750	2048	2090	2277	2291	2142	77.72
Carcass wt.(CW1), g	1257	1051	1161	1263	1368	1425	1276	50.12
Carcass wt.+total giblets (CW2), g	1358	1144	1279	1388	1503	1548	1411	53.54
Dressing percentages (DP) %								
DP1	53.67^{ab}	54.31^{ab}	50.78^{b}	54.23^{ab}	54.27^{ab}	56.21^{a}	53.69^{ab}	0.48
DP2	59.39^{ab}	60.10^{a}	56.20^{ab}	60.03^{a}	54.27^{ab}	56.21^{ab}	53.69^{b}	0.53
DP3	64.12^{ab}	65.51^{ab}	62.05^{b}	65.99^{ab}	66.04^{ab}	67.59^{a}	65.96^{ab}	0.52
Carcass cuts, g								
Fore part	383	320	340	373	395	399	392	15.45
Middle part	228^{ab}	191^{b}	236^{ab}	293^{a}	306^{a}	306^{a}	254^{ab}	12.65
Hind part	477	392	413	435	493	524	461	20.47
Head + Neck	168^{ab}	148^{b}	172^{ab}	161^{ab}	174^{ab}	196^{a}	168^{ab}	5.01
Slaughter wt. (SW), g	2348	1937	2266	2313	2520	2535	2370	86.02
External offal's, g								
Blood	80.33	63.33	96.67	90.33	73.00	89.33	77.33	5.72
Fur	340	249	264	2 82	329	308	288	14.78
Legs	85.33^{b}	79.33^{b}	113.6^{a}	83.67^{b}	93.33^{ab}	99.33^{ab}	89.67^{b}	3.16
Tail	16.67	10.67	14.33	16.33	19.33	20.33	16.00	1.22
Ears	35.33	30.67	42.00	35.33	38.33	35.67	35.33	1.39
Total	557.7	433	530.7	507.7	553	552.7	506.3	22.08
Edible offal's (Giblets), g								
Kidneys	17.67	16.33	18.33	20.00	20.00	19.00	19.33	0.76
Liver	61.00b^{c}	56.33^{c}	72.67^{abc}	83.33^{abc}	88.33^{ab}	76.67^{abc}	92.00^{a}	3.89
Heart	7.00^{c}	7.00^{c}	10.33^{ab}	7.67^{bc}	9.67^{abc}	11.68^{a}	8.00^{bc}	0.47
Lungs	14.00	12.67	15.67	13.33	16.33	15.00	15.00	0.76
spleen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Total	100.7^{ab}	93.33^{b}	118.0^{ab}	125.3^{ab}	135.4^{a}	123.3^{ab}	135.3^{a}	5.00
Digestive tract, g								
Full	433	357	456	418	463	433	453	15.41
Empty	206	170	238	195	220	189	224	9.33
Content	227	187	218	223	243	244	229	8.85

a, b and c: Means in the same row having different superscripts differ significantly (P≤0.05)
SEM:Standard error of the mean.
Dp1: CW/ SW. DP2: CW/ EBW. DP3: CW+ total edible offals (giblets/ EBW).

Also the obtained results are agreement with [18] who reported insignificant differences in the carcass weight and dressing percentage for rabbits fed biologically treated or untreated grapeposmace. [8]studied the effect of partial and completely replacement of clover hay by biological treated rice straw by bacteria, fungi and bacteria plus fungi in growing rabbit diets on carcass characteristics, the results indicated that rabbits fed either 25 or 30% of bacteria and fungi treated straw and those fed 25% of bacteria plus fungi showed insignificant differences with those fed control diet. However, the groups fed 35% bacteria, 35% fungi and 30% bacteria plus fungi significantly recorded the worst values of dressing percentages compared with the other groups. [9] found that the dressing percentage of rabbits fed diets contained 25 and 50% fungal treated sugar beet pulp (TSBP) (75.15 and 73.96%) were not different compared with control (72.14%), but it were significantly (P≤0.05) higher than 69.15 and 64.05% for rabbits fed 25 and 50% untreated sugar beet pulp (USBP). The edible giblets percentage, especially liver, kidneys and heart were higher for rabbits fed TSBP diets, especially at 50% compared with rabbits fed control and 25% USBP diets. Also the rabbits fed 50% USBP recorded higher kidneys and heart percentages. While [19] showed that dressing percentage was not affected by adding 0.5% dried yeast to rabbit diets compared with control group.

Chemical composition of the carcass meat:

Effects of treatments and levels and the interactions between them on chemical analysis of carcass meat for rabbits are presented in Tables (4 and 5). The resultsshowed that there are no significant differences among different levels on chemical composition of carcass meat. Concerning of the DM and ash content, there were no significant differences between treatments.While, incorporating of biological treated rice straw with *P.ostreatus* significantly (P≤0.05) decreased protein content (60.30%) in carcasscompared to those fed without *P.ostreatus* (64.69%), in contrast, EE was significanthigher (37.06%) for groups fed with *P.ostreatus* than (32.72%) for those fed without *P.ostreatus*. Effect of interaction between treatments and levels on DM and ash content were no significant for all experimental groups. While, rabbits fed with *P.ostreatus* at 66% had (P≤0.05) lower CP content than those fed without *P.ostreatus*. But, EE content was (P≤0.05) increased with 66% biological treated rice straw with *P.ostreatus* compared with those fed without *P.ostreatus*. In this respect, [7]reported that crude protein and ash percentages of L. dorsi muscle of rabbits did not statistically (P≤0.05) influenced by feeding biological treatment corn stalks. On the other hand, the dietary treatments (P≤0.05) affected on dry matter and ether extract contents. [20] found that adding probiotic in rabbit rations did not influencedon dry matter and ash contents of rabbits meat. While [9] indicated that chemical composition of lean meal showed (P≤0.05) higher content of DM, but (P≤0.05) less EE content for rabbits fed untreated sugar beet pulp (USBP) diets compared with control group. The rabbits fed fungal treated sugar beet pulp (TSBP) recorded (P≤0.05) higher ash content compared with those fed control and 25% USBP diets, while CP content was not (P≥0.05) different between all groups.

Table (4): Effects of biological treatment and substituting levels of rice straw on chemical analysis of ribs 9, 10 and 11th for rabbits.

Item	Treatments		SEM	Levels				SEM
	Without *P. ostreatus*	With *P. ostreatus*		0%	33%	66%	100%	
DM	37.74	38.77	1.06	35.92	38.87	39.23	38.99	1.06
CP	64.69^{a}	60.30^{b}	0.83	61.10	62.86	64.45	61.51	0.83
EE	32.72^{b}	37.06^{a}	0.82	36.24	34.66	32.94	35.75	0.82
Ash	2.59	2.64	0.08	2.66	2.48	2.61	2.74	0.08

a and b : Means within each treatment having different superscripts differ significantly (P≤0.05).
SEM:Standard error of the mean.

Table (5): Interactions effect between treatments and levels of rice straw on chemical analysis (%) of ribs 9, 10 and 11th for rabbits.

Item	0% (control)	Without *Pleuratus ostreatus*			With *Pleuratus ostreatus*			SEM
		33%	66%	100%	33%	66%	100%	
DM	35.92	37.40	37.11	40.52	40.35	41.35	37.47	1.06
CP	61.10^{bc}	65.57^{ab}	68.44^{a}	63.63^{abc}	60.14^{bc}	60.46^{bc}	59.39^{c}	0.83
EE	36.24^{ab}	31.94^{bc}	29.01^{c}	33.70^{abc}	37.37^{ab}	36.86^{ab}	37.79^{a}	0.82
Ash	2.66	2.49	2.55	2.67	2.49	2.68	2.82	0.08

a, b and c: Means within each treatment having different superscripts differ significantly (P≤0.05).
SEM:Standard error of the mean.

Conclusion

It could be that it can be replacing berseem hay by either treated rice straw without *P.ostreatus*(with medium only) or biologically treated rice straw with *P.ostreatus* up to 100% in growing rabbits diet.

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