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EVALUATION OF UREATED SOME POOR QUALITY ROUGHAGES AND ITS SPENT MATERIAL AFTER HARVESTING P. SAJUR-CAJU

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SUMMARY

Rice straw (RS), bean straw (BS) and sugar cane bagasse (SCB) were chopped to 3 cm length and were evaluated either untreated, ureated or their spent materials after harvesting Pleurotus sajur-caju. The materials were ureated by treating with 5% urea solution (1:1) and ensiled in well tight plastic bags for 28 days. The corresponding spent materials were obtained after inoculating the roughages by P. sajur-caju and harvesting the mushroom fruits (90 days). The resultant materials were air dried and subjected for chemical analysis. In addition, their in vitro DM and OM digestibilities were determined.

Compared to the untreated roughages, urea treated material contained up to 180-458% more CP while CF content decreased by 2-12%. The CF content of the spent mateial was less by 5-44%; CP content was more by 75-155% and ash more by 73-85%. In this experiment, rice straw was the most roughage affected as indicated by improving both its IVDMD and IVOMD. The chemical composition and digestibility of the resultant materials after harvesting mushroom or urea treatment seem to be dependent on the nature and physical form of lignocellulose molecules in the different roughages.

Keywords: Poor roughages, ureated, spent materials.

INTRODUCTION

In Egypt, the agricultural crops generate plentiful and inexpensive by-products available around the year but are not efficiently used (16.3 million tons of cereal straw in addition to many millions of other by-products, FAO, 1986). If properly prepared, they can be used as feedstuffs for ruminants, otherwise, they may be a source of environmental pollution. These wastes are characterized by their low nitrogen content, high fiber content and consequently are of poor palatability and feeding value.

Lignocelluloses are the most abundant naturally found in these wastes (Crawfor, 1981). Their molecular structure represents a barrier to the biodegradation and digestibility by ruminants (Zadrazil, 1977 and Lindenfelser et al., 1979). There are many approaches to magnify their role in solving nutrition problem in feeding ruminants. Among these is urea treatment which is the most chemical treatment approved as NPN to increase its nitrogen content (Manson and Owen, 1985).

In recent years, much attention has been directed toward the development of protein sources that can be used as food for human consumption (Mushroom) by cultivation white rot basidiomycetes on these wastes particularly in developing countries.

Mushroom protein is a very delicious and nutritious food and has gained popularity in different parts of the world. In addition, the mushroom spent remained after harvesting would offer a spectrum of potential applications such as humus fertilizers for horticulture crops (Wang et al., 1984); for production of hydrolyzing enzymes (Rajarathnam et al., 1979); for biogas production (Muller and Trosch 1986); or in feeding ruminants (Kirk et al., 1980 and Bano et al., 1986). Mycelium left in the roughages increase their protein content (Levanon et al., 1988). Pleurotus sajur-caju was found to be one of the white rot fungi which efficiently increases digestibility and nutritional quality of poor roughages (Bano et al., 1986). It is distributed in the subtropics and can fruit at both extremes around 18°C and 31°C (Rajarathnam and Bano, 1987).

The objective of the present work was to study the effect of urea treatment (5% solution) or cultivation of P. sajur-caju on chemical composition and in-vitro digestibility of some poor quality roughages.

MATERIALS AND METHODS

Representative samples of rice straw, bean straw and sugar cane bagasse were chopped into 3-4 cm length. These materials were treated with 5% urea solution (1:1) and were ensiled for 28 days in well tight plastic bags. Another part of the chopped materials was watered to the run-off point for 3 days and filled into 0.37 m2 trays and put in water boiler for four hrs for pasteurization. They were allowed to cool and stacked in bandles in a cross fashion. Then they were inoculated with 1/4 kg of P.sajur-caju spores for each 12 kg roughage. The roughages were packed in plastic bags in which some holes were made for proper aeration and well closed and kept in room temperature for 2-3 weeks. Thenafter, the bags were opened and left in air and light for two weeks. Many flushes of mushroom fruits were harvested. The fruits yield was calculated as biological efficiency (BE% = weight of fresh mushroom ÷ weight of dry substrate x 100) according to Chang et al, 1981). Samples of the remaining spent material were air dried and well ground for chemical analysis. The chemical composition of the fruits, the untreated and treated materials was determined according to A.O.A.C. (1980). The NFE was calculated by difference. Fiber fractions including neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Goering and Van Soest (1970). Two stage in-vitro technique was applied to determine the in-vitro dry matter digestibility (IVDMD) and in-vitro organic matter digestibility (IVOMD) of the experimental roughages according to Tilley and Terry (1963). Statistical analysis was performed using the general linear model procedure (SAS, 1982). Least significant difference (LSD) between means was calculated after Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Data concerning the chemical composition of the different roughages before and after urea treatment or after harvesting mushroom fruits (Table 1) showed that urea treatment decreased the CF and NFE content of RS by

12 and 4%, respectively. On the other hand, CP, EE and ash contents were increased by 190%, 8% and 3%, resp., while OM content was not greatly affected. Regarding the CF constituents, NDF, ADL, hemicellulose were decreased by 2%, 2% and 9%, respectively. The same trend could be noticed with both BS and SCB but in different ratios. It could be noticed that only about 40% of the added N as urea was retained in the experimental materials. The loss of N was previously approved by Dias-da-Silva and Sundstol 1980.

Table 1. Chemical composition of untreated, spent and siled ureated rice traw, bean straw and sugar cane bagasse

Item	Rice straw			Bean straw			Sugar cane bagasse		
	RS	SRS	URS	BS	SBS	UBS	SCB	SSCB	USCB
Moisture% (air dried)	8.40	8.87	9.78	11.55	9.97	14.45	7.85	8.28	9.34
Dry Matter Composition%									
Organic matter	85.12	72.43	84.64	90.04	82.70	88.48	97.17	94.88	96.91
Crude protein	3.00	5.56	8.71	3.17	5.55	8.88	1.19	3.04	6.64
Crude fiber	40.50	22.69	35.65	40.80	34.70	39.97	42.29	40.06	40.88
Ether extract	1.62	1.28	1.75	1.49	1.30	1.80	1.10	0.98	1.22
N-free extract	40.00	42.90	38.53	44.58	41.15	37.83	52.59	50.80	48.17
Ash	14.88	27.57	15.36	9.96	17.30	11.52	2.83	5.12	3.09
Silica	11.76	25.20	11.88	3.28	8.39	3.72	1.29	3.53	1.42
Silica/ash ratio	79.03	91.37	77.34	32.93	48.50	32.29	45.58	68.94	45.96
Curde fiber fractions% (DM basis)									
NDF	79.85	67.99	77.99	58.37	64.47	57.84	76.21	86.13	78.62
ADF	54.13	59.14	54.64	44.82	53.89	46.56	47.66	61.48	50.25
ADL	7.09	7.36	6.94	9.23	9.50	9.05	11.17	11.76	11.10
Cellulose	47.04	51.78	47.70	35.59	44.39	37.51	36.49	49.72	39.15
Hemicellulose	25.72	8.85	23.35	13.55	10.58	11.28	28.55	24.65	28.37

RS :Untreated rice straw SRS :Spent rice straw URS :Ureated rice straw
BS :Untreated bean straw SBS :Spent bean straw UBS :Ureated bean straw
SCB:Untreated sugar cane bagasse SSCB:Spent sugar cane bagasse USCB:Ureated sugar cane bagasse

Generally, the CP content of all the experimental roughages was increased by 180-458% when treated by urea solution 5%. Meanwhile, their CF content was decreased by 2-12%. These results agree with those obtained by Mira et al. (1983). The results also indicated that the raw sugar cane bagasse (SCB) was the highest in OM content while RS was the lowest which was reflected on ash content. Silica, a barrier for feed utilization, represented a high percentage of ash in RS being 79%. The SCB was the lowest in CP content, being a residue rich in carbohydrates.

The SRS after harvesting mushroom fruits showed a decrease in OM, CF and EE content by 15%, 44% and 21%, respectively. On the other hand, CP, NFE and ash contents were increased by 118%, 7% and 85%, resp. Meanwhile, NDF and hemicellulose decreased by 15% and 66% while ADL was not greatly affected. The same trend was nearly noticed with both SBS and SSCB.

Generally, cultivation of fungi increased the CP content of substrates in a range between 75% and 155% while the CF content decreased by 5-44%. The increase in CP concentration is not real since it could be attributed to the loss in other organic compounds in form of CO_2 as a result of fungal metabolism. Mycellium left in the substrate after harvesting therefore increased the CP concentration. Due to the same loss in organic matter, ash content increased by 73-85%. The loss in DM content amounted to 15-30% in boiling water for pasteurization and 53-64% after harvesting which agree with the results obtained by Calazada et al. (1987) and Nicolini et al. (1987) who determined the OM loss to range between 20% and 67% depending on substrate composition and species of fungi. The anabolism of nutrients into fruits is probably another source of losses of nutrients from the substrates.

Data in Table 2 revealed that substrate would not affect the protein content of the produced fruit bodies since it contained between 22.9% and 25.6% without significant differences. The BE% of P. sajur-caju was highest when grown on BS followed by RS. Sugar cane bagasse showed the lowest BE% and sporophore weight. In this respect, Kewalramani et al. (1988) suggested that sucrose in sugar cane bagasse might not be used efficiently by all species of Pleurotus.

The above results indicated that both bean straw and rice straw could be considered as good substrates for cultivation of P.sajur-caju. These results agree with those obtained by Madan et al. (1987).

On the average, fruit bodies of P.sajur-caju (80.4% moisture) contained 25.29% CP, 6.03% ash, 16.41% CF, 1.70% EE and 50.57% NFE on DM basis. It could be noticed that carbohydrates and protein represented the major components of the fruits.

Table 2. Effect of substrate on protein content, the percent biological efficiency and sporophore weight of Pleurotus sajur-caju

Substrate	Substrate CP%	Fruit bodies CP%	Biological efficiency%	Weight g/ sporophore
Rice straw	3.00	22.99a	49.78b	3.39b
Bean straw	3.17	25.66a	72.25a	5.21a
Sugar cane bagasse	1.19	24.60a	29.22c	2.32c

a,b,c Means with different superscripts in the same row are significantly (P<0.05) different

Data in Table 3 indicated that both IVDMD and IVOMD of spent rice straw were significantly increased to 34.1% and 41.5%, respectively compared with that of raw straw being 30.6% and 35.2% in the same order. The difference between the IVDMD and IVOMD may be due to the high ash content of dry matter. The improvement in the IVDMO may have been related to the decreased CF, NDF and hemicellulose content and to the increased CP content. On the other hand, digestibilities of both SBS and SSCB were significantly reduced compared with the raw materials. These results coinside with the fact that both degradation and digestibility of colonized substrates are influenced by substrate composition (Kamra and Zadrazil, 1986).

Regarding the chemical effect, both digestibilities of URS were significantly increased compared with the raw straw. On the other hand, IVDMD of UBS and USCB was significantly reduced while their IVOMD was comparable to the raw materials. This could be attributed to the nature of lignin in the different plant species. It was found that legumes lignin resists the effect of chemicals while cereal lignin is soluble (Abou-Raya, 1967). In this connection, Danai et al. (1986) noticed a significant relationship between lignin content and IVDMD. The present results confirm the previous results of Gordon and Chesson (1983).

Table 3. In-Vitro digestibility of untreated, spent and siled ureated rice straw, bean straw and sugar cane bagasse

Item	IV PHP%	IV DMD%
- Rice straw		
RS	30.66c	35.19b
SRS	34.13b	41.49a
URS	40.93a	41.89a
± S.E	0.84**	1.51**
- Bean straw		
BS	55.05a	53.18a
SBS	24.47c	27.78b
UBS	51.06b	49.97a
± S.E	0.88**	1.17**
- Sugar can bagasse		
SCB	52.89a	52.06a
SSCB	21.14c	20.43b
USCB	50.54b	50.91a
± S.E	0.71**	0.67**

a,b,c Means with different superscripts in the same column are significantly ($P<0.05$) different.

RS :Untreated rice straw SRS :Spent rice straw URS :Ureated rice straw
BS :Untreated bean straw SBS :Spent bean straw UBS :Ureated bean straw
SCB:Untreated sugar cane bagasse SSCB:Spent sugar cane bagasse USCB:Ureated sugar cane bagasse

It could be concluded that rice straw was the most suitable waste for the treatment with urea solution 5%. Bean straw and rice straw were suitable substrates for cultivation of P. sajur-caju which would not only serve a very delicious food for human but also improve the quality of spent straw. This encourages for further investigations to study the effect of treated rice straw; being produced in big amounts, on performance of ruminants. Meanwhile, it is of great importance to choose the fungi species with the suitable substrate and optimal conditions to get more mushroom yield and to improve quality of the spent material.

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تقييم بعض مواد العلف الخشنة بعد معاملتها باليوريا أو بعد حصاد المشروم

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تم تقطيع كل من قش الأرز وتبن الفول ومصاصة قصب السكر إلى أطوال ٣ سم وتمت زراعتها بفطر بلوروتس ساجوركاجو ثم حصاد المشروم (٩٠ يوما) ليستخدم فى تغذية الحيوان . وفى نفس الوقت عوملت نفس المواد الخشنة بمحلول اليوريا ٥٪ (١:١) وتم حفظها فى صورة سيلاج لمدة ٢٨ يوما فى أكياس من البلاستيك. وتم تجفيف وطحن المواد لتحليلها كيماويا مع تقدير معامل هضم المادة الجافة والمادة العضوية بطريقة الهضم فى المعمل (In vitro).

وقد لوحظ إنخفاض محتوى الألياف الخام بعد حصاد المشروم بنسبة ٥-٤٤٪ مع إرتفاع نسبة البروتين الخام بنسبة ٧٥-١٥٥ ٪ وإرتفاع نسبة الرماد بنسة ٧٣-٨٥٪. كما أظهرت النتائج أن معاملة المواد الخشنة بمحلول اليوريا أدت إلى رفع محتوها من البروتين الخام بنسبة ١٨٠ -٤٥٨٪ مع إنخفاض محتواها من الألياف الخام بنسبة ٢-١٢٪ .

وقد ظهر من هذه التجربة أن قش الأرز هو الأكثر إستجابة حيث سجل أعلى قيمة هضمية لكل من المادة الجافة والمادة العضوية . وإتضح من نتائج التركيب الكيماوى ومعامل الهضم أن تأثير المعاملة باليوريا أو تنمية الفطر تتوقف على طبيعة وشكل جزيئات اللجنوسيللوز فى مواد العلف الخشنة.