# CHEMICAL COMPOSITION AND DIGESTIBILITY OF CEREALS STRAW WITH OLIVE CAKE OR TOMATO POMACE

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## SUMMARY

This experiment was carried out to investigate nutrient contents, fiber fraction, *in vitro* digestibility values, *in vivo* digestibility and nitrogen balance of olive cake mixed with cereals straw (OCS) and tomato pomace mixed with cereals straw( TCS) after its inoculation by *Pleurotus Ostreatus* fungi, then mushroom harvested for eight weeks. Fungal treatment increased the crude protein but decreased the cell wall components. The *in vitro* digestibility is lower in the fungal treated mixtures. No significantly difference in the digestibility between untreated and treated mixtures. Nitrogen balance was significantly difference ($p<0.01$) between the treatments, which was lower for the treated mixtures. In conclusion spent OCS and spent TCS can be used only as roughage in ruminant animals.

***Keywords**: olive cake, tomato pomace, pleurotus ostreatus fungi*

## INTRODUCTION

Cereals straw (CS), olive cake (OC) and tomato pomace (TP) are the most by-products available and use as a feed for sheep in Jordan. They are contain considerable quantity of cellulose and hemi-cellulose that can be used as energy source for ruminants, but because of lignocelluloses binding in these by-products, the bio availability of these carbohydrates are limited as the rumen microbial population does not possess lignolytico activity.

As a result, a large proportion of the potentional energy in lignified by products remains unavailable (Harb, 1986a and b). In order to brake done the lignocellulosic bond of these by products to increase their nutritive value, various chemical and physical delignification methods have been extensively tested (Molina *et al.*, 1988; Hadjipanayiotu *et al.*, 1993 and El-Shakhret *et al.*,1996).

Since last decades, biological de-lignifications of straw by soiled–state fermentation has been considered because of its capacity to remove lignin preferentially (Fazaeli *et al.*,1999; Moyson and verchtert, 1991). Attempts had been made to identify species of white-rot fungi for their ability to grow on straws and other by-products that improve their nutritive value (Yamakawa *et al* ., 1992; Arora *et al.*, 1994; Zadrazil *et al.*,1996 and Hameed *et al.*, 2005)

Utilization of cereals straw treated with white-rot fungi as animal feed was studied by some workers (Kakkar *et al.*, 1990; Moyson and Verachtert, 1991 and Fazaeli *et al.*, 2004).

Despite the fact that numerous biological and /or chemical solutions have been proposed for olive mill wastewater treatment (Hamidi, 1992). Very little attention was paid to the treatment of olive cake as a solid-by products (Al-Qsous, 1998). However previous studied utilized composted olive cake for various purpose. Hameed *et al.* (2005) made a study proved that the olive cake is suitable for cultivating basidiomycetes fungi such as *P.Sajor-caju, P.Ostreatus* and *P.Chrysosporium*.

Such preliminary result suggested olive cake to be a good candidate for further investigation for growing other types of fungi to biodegrade or bioconversion the material and at the same time, produce fungal secondary metabolites. Growth of these fungi on olive cake–straw caused drastic changes in the physical and chemical properties of the substrate which may have improved its nutritional value.

Ayson *et al.* (1985) reported that any decrease in fiber content of finer-rich substrate used as an ingredient in animal feed may improve and /or increase its digestibility. Therefore, cultivation of lignolytic fungi on CS, OC and TP mix may be render this substrate to be more suitable substitute for some components in animal rations.

The aim of this investigation is to study the digestibility of cereals straw mix with olive cake and cereals straw mix with tomato pomace after the mushroom was harvested.

## MATERIALS AND METHODS

### *Substrate preparation:*

The first substrate was mixture of cereals straw 60% , olive cake 30%, wheat bran 5% and gypsum 5% , the second substrate was mixture of cereals straw 60%, tomato pomace 30%, wheat bran 5% and gypsum 5%. After preparation of two substrate placed in a sieved clothes bag then completely submerged in a water bath inside a large tank at 100 °C for 1.5 hr, then removed from the water bath, allowed to drain ,cold to about 30-40 °C , then placed in a large plastic sheet in order to mixing the

spawn with the substrate by mixing manually, then it was inoculated with *pleurotus ostreatus* at rate of 5% of the dry matter basis.Then the bags were punched and tied, the temp 25 °C, humidity 80%, with completely darkness until the compost was completely colonized by the mycelium, then exposed to cold chock around 5 °C for 1 day. During the fruiting period ventilation is very important. Mushroom was harvested from the substrate when the caps were fully mature, harvested period was one and half month, then the compost bags were removed and dried under the sun after that samples were taken then stored to use them in the trial.

***Chemical analysis and in vitro digestion:***

Samples were taken to the veterinary labs to check for harmful fungi and bacteria (*A. Flavus, Alafoxicose, Ovine salmonellosis* and *brucella abrtus*).

Other samples at the same times were taken for chemical analysis, fiber fractions and *in vitro* digestion .The organic matter (OM) was measured by ashing the samples at 500 °C for 4 hr. Crude protein (CP) was analyzed by Kjeldal method, crude fiber (CF)was determined according to the method represented in AOAC (1990).Cell wall component including acid detergent fiber (ADF) and neutral detergent fiber(NDF) were determined by using the methods of Van Soest *et al.* (1991).Acid detergent lignin(ADL) was measured according to the AOAC (1990).The *in vitro* digestibility was determined by using the method of Tilley and Terry,(1963).

***In vivo digestibility:***

A one week pre-test was considered to understand the acceptability and voluntary intake of the experiment diet as below. The experimental animal were divided to four groups as follows using 12 Awassi mature rams weighing 56.5±2.2 kg (three animals each):

Untreated cereals straw mixed with olive cake (UCO).

Untreated cereals straw mixed with Tomato pomace (UCT).

Spent cereals straw mixed with olive cake (SCO).

Spent cereals straw mixed with Tomato pomace (SCT).

The experiment was completed in three weeks, two weeks for adaptation and one week for collection. Feed intake was recorded and samples of feed and residues were collected during the collection period, and frozen at -20 °C until processed for the analysis. Feces from individual animals were collected every morning and weighing then 10% was kept. The samples from feed residues and feces were dried at 65 °C for 48 hr. The dried samples were ground through awiley mill with 1-mm screen, and then composted for analysis. Using plastic containers, urine was collected weighed and recorded, then 5% was kept to evaluate N retention, each bottle had 50 ml of 1N HCL to prevent ammonia losses.

***Statistical analysis:***

The collected data were analyzed using the GLM of SAS soft ware (1995). Least square were calculated for all measured variables and the protected LSD test was used to determine significant differences.The following model was use:

$$YiJK=\mu + Ti+e\ ijk$$

Where: YiJK=represent observations, μ=0verall mean, Ti=Treatments, e ijk=Experiment error.

## RESULTS AND DISCUSSION

***Chemicals analysis and in vitro digestion:***

The veterinary labs reported that all the samples were free from any foreign

**Table (1). Chemicals analysis and fiber fraction and in vitro digestibility for SCO (spent cereals straw mixed with olive cake), UCO (untreated cereals straw mixed with olive cake), SCT (untreated cereals straw mixed with Tomato pomace) and UCT (spent cereals straw mixed with Tomato pomace) (as dry matter basis%).**

| Items | SCO | UCo | SCT | UCT |
|---|---|---|---|---|
| Dry Matter | 92.80 | 92.00 | 91.70 | 90.10 |
| Organic Matter | 81.57 | 88.42 | 77.21 | 81.90 |
| Crude Protein | 9.59 | 4.46 | 13.63 | 7.26 |
| Crude Fiber | 25.22 | 33.22 | 19.84 | 28.77 |
| Ether Extract | 0.40 | 1.79 | 1.82 | 3.35 |
| Nitrogen free Extract | 46.36 | 43.95 | 41.92 | 42.52 |
| Ash | 18.43 | 16.58 | 22.79 | 18.10 |
| NDF | 64.45 | 85.34 | 54.00 | 76.30 |
| ADF | 14.61 | 60.25 | 38.31 | 57.15 |
| ADL | 21.08 | 24.82 | 23.16 | 16.58 |
| Cellulose | 28.67 | 25.09 | 15.68 | 18.89 |
| Hemi cellulose | 12.04 | 35.43 | 15.15 | 40.57 |
| Lignin | 49.63 | 23.00 | 17.52 | 12.71 |
| In Vitro DM | 36.37 | 67.88 | 47.36 | 58.88 |
| In Vitro OM | 34.26 | 54.87 | 34.76 | 55.45 |

**Table (2). The nutrients digestibility of untreated and spent diets.**

| Items | SCO | UCo | SCT | UCT | Trt. |
|---|---|---|---|---|---|
| Digestibility (%) | | | | | |
| Dry Matter | 51.2±4.0 | 54.9±4.0 | 60.2±4.08 | 52.0±4.0 | N.S |
| Organic Matter | 56.6±4.3 | 55.4±4.3 | 62.7±4.30 | 52.7±4.3 | N.S |
| Crude Protein | 42.3±3.2 [a] | 56.2±3.2 [b] | 42.1±4.20 [a] | 46.8±3.2 [ab] | ** |

[a,b,c] Means within the same row with different superscripts differ according to the indicated level of significance
NS = non significant; * = P<0.01.

**Table (3) : N- balance of untreated and treated cereals straw.**

| Items | SCO | UCo | SCT | UCT | Trt. |
|---|---|---|---|---|---|
| N balance | | | | | |
| N output in feces | 7.2±0.9 | 6.1±0.9 | 4.4±0.9 | 5.3±0.9 | N.S |
| N output in urine | 6.2±0.9 | 3.7±0.9 | 3.7±0.9 | 4.2±0.9 | N.S |
| N intake | 12.8±1.8 | 13.9±1.8 | 7.5±1.8 | 10.0±1.8 | N.S |
| N retained | -0.65±1.1 [a] | 4.1±1.1 [b] | - 0.56±1.1 [a] | 0.44±1.1 [a] | ** |

[a,b,c] Means within the same row with different superscripts differ according to the indicated level of significance
NS = non significant; * = P<0.01.

fungi, harmful bacteria and can use in animals feed. Table (1) shows the chemical analysis of UCO, SCO, UCT and SCT. It shows that the OM decreased from 88.42 to 81.57 and from 81.90 to 77.2, respectively, but the CP increased from 4.46 to 9.59 and from 7.26 to 13.63 %, respectively. These results are agreement with Fazaeli *et al.* (2006) and Mahrous *et al.* (2005). The increase of CP IN SCO and SCT was due to the capture of excess nitrogen by aerobic microbes and conversion at the same time into microbial protein during solid-state fermentation (Dahanda *et al.* 1994). CF content was decreased in both treatments ,the results agreed with Gado,1999; Mahrous *et al.*, (2005) and El-Ashry *et al.* (2002), this decrease may be due to the fact that fungus depends on carbohydrates including CF as carbon source to grow up and convert them into microbial protein. SCO and SCT contained considerably lower NFE, NDF, ADF, cellulose

and hemi-cellulose than UCO and UCT, which is similar to the results reported by others(Fazaeli *et al.*, 2006; and Dahanda *et al.*, 1994), this could be result of decreased OM in the SCO and SCT (Bakshi and langer,1991;Maeda *et al* ..1993). DM *in vitro* digestibility was decrease in UCO,SCO,UCT and SCT from 67.88 to 49.63,and 58.88 to 47.36, respectively, also *in vitro* OMD decrease from 54.87 to 36.37 and from 55.45 to 34.37,respectively. These result are not in accordance with the results of Zadrazil (1997) and Calazada *et al.*, (1978). It could be because of the culturing condition. the ability of various strains of white-rot fungi in cell wall degradation and the digestibility of the by product used is different (Tripathia and Yadav,1992; Jalc *et al.* 1997).

***In vivo digestibility:***

Table (2) shows the digestibility result for UCS, SCO, UCT and SCT, which illustrate there were no significantly difference in DM digestibility and OM digestility among all groups, this result agree with Bader (2001) and El-Marakby (2003), also, it in accordance with Fazaeli and Masood ,(2006) and Calzada *et al.*, (1978).These results may be due to the high level of ash and may contain relatively high amount of silica that limits the digestibility (Bakshi and Langar, 1985; Sharma *et al.*, 1991) other reporters (Tamang *et al.*, 1992) illustrate that the digestibility decrease because of high level of acid insoluble ash and lignin.

It well established that nitrogen retention depend on the intake of nitrogen ,amount of fermentable energy source ,urinary and faecal excretion .The result in Table (3) shows that the N-retained is negative in the SCO and SCT, this result agreed with Fazaeli and Masood (2006), when they fed 30 % of the total ration spent wheat straw, this reduction is due to that, the nitrogen retention depends on the fermentable carbohydrate of the diet (Sarwar *et al.* 2003). Therefore, decreasing of metabolism may have resulted in negative nitrogen balance.

## CONCLUSION

It can be conclude that *pleroutus ostreatus* didn't improve the nutrients digestibilities of harvested spent cereals straw mixed with olive cake and cereals straw mixed with tomato pomace, so we can use such substrate for growing mushroom than as roughage.

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## التركيب الكيميائي ومعامل الهضم لتبن الشعير،جفت الزيتون وتفل البندوره المعامل بفطر عيش الغراب المحاري.

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أجريت هذه الدراسة في محطة الخناصري التابعة للمركز الوطني للبحوث ألزراعيه بهدف دراسة معامل الهضم لتبن الشعير مع جفت الزيتون (معاملة الجفت) وتبن الشعير مع تفل البندوره (معاملة البندوره) المعامل بفطر عيش الغراب ألمحاري ( Pleurotus ostreatus) ،حيث استخدمت هذه ألمخلفات لزراعة فطر عيش الغراب ألمحاري ،استمرت ألزراعه ثمانية أسابيع،تم حصاد للفطر عدة مرات، أخذت عينات قبل ألزراعه وبعد الحصاد لدراسة التحليل الكيميائي ومعامل الهضم.بينت الدراسة ارتفاعا بنسبة البروتين في المعاملتين حيث ارتفع من 4.46الى 9.59% في معاملة الجفت ومن 7.26الى 13.63 % في معاملة البندوره في حين انخفضت ألماده ألعضويه ،الألياف الخام،المستخلص ألدهني والمستخلص خالي ألأزوت، أما معامل الهضم للمادة الجافة والمادة ألعضويه لم يتأثر معنويا في كلتا المعاملتين ،بينما انخفض معامل هضم البروتين معنويا (P<0.01)) في المعاملتين.

تبين هذه الدراسة أنه يمكن استخدام هذه المخلفات بعد حصاد الفطر كعلف مالئ فقط.