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EFFECT OF FEEDING SPROUTED BARLEY GRAINS ON RICE STRAW AND OLIVE CAKE ON PERFORMANCE OF GOATS IN SINAI

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SUMMARY

The present experiment was aimed to study the effect of sprouted barley grains (*Hordeum vulgare* L.) on a mixture of olive cake and rice straw (50:50) as a media without (T2) or with 1% (T3), 2% (T4), or 3% (T5) of urea solutions in comparison with the control Alfalfa, (*Medicago sativa*). All diets were fed *ad libitum* for 45 days. The experiment was performed on twenty desert male goats (18 months old) with an initial body weight of 24.34±1.29 kg randomly divided into five equal groups, (4 animals per group). Five digestibility trials were conducted to evaluate nutrients digestibility and nitrogen balance for experimental roughages. Results showed that the treatments with sprouted barely increased CP content while OM, NDF, ADF and ADL contents were decreased. The highest values of DMI due to the higher palatability for animals fed T5 compared with control group; the same group revealed a significant improvement on CP, EE, NDF and hemicellulose digestibility. The highest TDN% value was recorded by animals fed T5 (58.55%) followed by T1, T4, T3 and the lowest value was for T2. Highest ($P \leq 0.01$) DCP% was 9.24% which recorded by T1 followed by T5, T4, T3 and T2, respectively. All animals were in positive N-balance but animals fed on T2 retained the least amount of nitrogen balance (mg/kg BW) among treatments. Goats fed sprouted barely grains treated with urea solutions had significantly ($P \leq 0.01$) higher total volatile fatty acids and ammonia concentrations in rumen at 3 hours post feeding. In conclusion, goats in T5 recorded the best TDN, DCP and nitrogen balance with normal blood parameters.

Keywords*: *goats*; *sprouting* barley; *olive cake*; *rice straw*; *chemical composition*; *nutritive value*; *rumen and blood parameters.

INTRODUCTION

The shortage of animal feeds in Egypt necessitates that intense research efforts should be directed towards exploring the possibility of using new-non conventional sources or agricultural by-products as animal feed and improving their nutritive values (Shoukry *et al*., 1985) cereal crops generate large amount of organic agricultural waste in many countries. Rice plant (*Oryza sativa* L.), is one of the most abundant crop in Egypt, 2 million feddans (EEAA, 2008) with an average production of about 6.12 million tons per year and 9.5 tons per hectare in 2005 (FAO, 2011). In Egypt, there are about 30 million tons of agricultural residues available per year. Rice straw is a major crop residue in surplus amounts (Al-Asfour, 2009 and Shoukry, 2013). About 20% of rice straw was used for other purposes such as ethanol, paper and fertilizers production as well as fodders (El-Gammal and Shakour, 2001) and the remaining part was left on the fields for burning within a period of 90 days (from October to mid-December) get quick rid of the leftover debris. The resulting emissions significantly contribute to the air pollution called the black cloud (Keshtkar and Ashbaugh, 2007). However, rice straw is characterized by low level of CP and high level of structural polysaccharides, which drastically affected the DM intake, digestion and ultimate performance (Wanapat *et al*., 1985; Chemjon, 1991; Safari *et al*., 2011). Another problem is that great. Urea treatment may be the most suitable method for small-scale farmers to improve the feed quality of straws (Hanafi *et al*., 2012). Urea treatment of rice straw could increase its nutritive value, improved overall intake, nutrient digestibility, VFA production and increased passage rate of particles in the rumen (Hart and Wanapat, 1992; Abate and Melaku, 2009). Areas are cultivated by olive trees, especially in Sinai and the North-Western Coast Zone, therefore, there are great amounts of olive by products without beneficial usage and are considered as wastes. In South Sinai, there is a great shortage of animal feedstuffs, while olive cake represents the majority of agro-industrial by-products. About 7440 ton of olive fruits are annually produced and about 640 ton of olive cake remains after oil extraction (Information Center of South Sinai Governorate, 2014). Olive cake could be used for ruminant nutrition, but their use is limited because of their low nutritive value (Sansoucy *et al*., 1985), high NDF and ADF (Nefzaoui, 1983), condensed tannins (Martin Garcia *et al*., 2003), seasonality (Sansoucy *et al*., 1985) and low degradability of cell wall components (Filya *et al*., 2006b; Teimouri Yansari *et al*., 2007). The major limitations of using these residues as ruminant feedstuff are their poor nutrient contents such as protein and vitamins and high fibers with low digestibility, low palatability and high lignin contents. Nowadays great interest has been oriented to increase by-product utilization all over the world due to economic factors and pollution. Therefore, sprouting as a simple technological method that is used to germinate seeds has been reported to improve the nutritive value of seeds (Amal *et al*., 2007). The adoption of this technique has enabled production of fresh forage from oats, barley, wheat and other grains (Rodriguez-Muela *et al*., 2004). Several studies on the effect of germination on seeds found that germination can increase protein, fiber, reduce tannin and phytic acid contents and increase mineral bioavailability (Rao and Prabhavathi, 1982; Hussein and Ghanem, 1999; Ghavidel and Prakash, 2007). Germination also was reported to be associated with increase of vitamin concentrations and bioavailability of trace elements and minerals (El-Adawy *et al*., 2004). Also, sprouting improved the protein digestibility by decreasing the anti-nutritional factors (Mahmoud and El-Anany, 2014; Rubio *et al*., 2002). The animal consumes the whole plant including seed and roots (Resh, 2001). Because of its aspect, color, taste and texture, it is considered a highly palatable feed that promotes digestibility of other nutrients (FAO, 2001).

This study focuses on the use of the simple process of sprouting barley grains on dried agricultural by-products as media (olive cake and rice straw) to produce green fodder with urea solution to increase the nutritive value, palatability, digestibility, nitrogen retention, rumen characteristics and serum constituents of these by-products as fed to goats.

MATERIALS AND METHODS

The trial was carried out at the South Sinai Research Station, Desert Research Center, Sinai Peninsula, about (200 km South East of Cairo).

Preparation of seeds before planting:

Seeds were cleaned from debris and other foreign materials. Then the cleaned seeds were sterilized by soaking for 30 minutes in a 2% sodium hypochlorite solution to control the formation of mould. Planting trays were also cleaned and disinfected. The seeds were then washed well from residues of bleach and resoaked in tap water overnight (about 12 hours) before planting.

Production of sprouted barley:

Production method for grains sprouting in trays was applied as described by (Mohammadi et al., 2007) using about 7-10 cm thick layer of rice straw and olive cake as sprouting media. Cereal grains of local barley (Hordeum vulgare L.) were cleaned from debris and other foreign materials. At the end of the soaking period, soaked seeds were spread on the top of the tested media. Germination period on the media surface lasted about 15 days to get shoot sprouts, shoot length was 22-25 cm. The 1-3% urea solution (46.5% N) on DM basis was used as a source of nitrogen fertilizer, seeding rate used in this experiment was about 15% density of the roughage media. Planting trays were irrigated with tap water once a day early in the morning to provide enough water to keep the seeds/ seedlings moist.

Animals and rations:

Twenty desert male goats (Egyptian goats breed) with an average body weight of 24.34±1.29 kg (18 months of age) were randomly divided into four equal groups (4 animals each). The experiment was lasted fourty five days in which goats were feeding one of the next dietary treatments as follow:

T1: Alfalfa (Medicago sativa) ad libitum (control).
T2: sprouted barley grains on 50% rice straw + 50% olive cake ad libitum.
T3: sprouted barley grains on 50% rice straw + 50% olive cake treated with 1% urea ad libitum.
T4: sprouted barley grains on 50% rice straw + 50% olive cake treated with 2% urea ad libitum.
T5: sprouted barley grains on 50% rice straw + 50% olive cake treated with 3% urea ad libitum.

A feeding experiment followed by a metabolism trial was conducted.

Digestibility trial:

At the end of the feeding period, animals of were subjected to the metabolism trial, that was lasted for 10-day adaptation period followed by 5-day collection period.

During the collection period, total fecal and urine were daily collected and sampled (10% by weight of daily samples). Daily water intake was available twice daily and recorded. At the end of the collection period, rumen liquor was sampled by a stomach tube at 0, 3 and 6 hours after feeding. Blood samples also were taken from jugular vein after feeding.

Chemical analysis:

The dry matter (DM) and crude protein (CP) were determined according to A.O.A.C. (1997). The neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were determined according to Goering and Van Soest (1970). Rumen total volatile fatty acids (TVFA's) were (Warner, 1964) and ammonia nitrogen values were also evaluated. Sodium (Na) and potassium (K) were determined by using the standard flame photometer (Jackson, 1958). Blood serum samples were assayed for total protein (Armstrong and Carr, 1964) and albumin (Doumas *et al.*, 1971), while globulin was calculated by the difference between. Serum creatinine (Henry, 1965) and urea (Patton and Crouch, 1977) were also determined. All blood serum analysis were estimated using Jenway spectrophotometer (UK).

Statistical analysis:

Collected data were analyzed using the general linear models (SAS, 1998). The used design was one way analysis of variance and differences between mean values were compared by (Duncan, 1955).

RESULTS AND DISCUSION

Chemical composition of the tested rations:

The chemical compositions of different tested feeds are shown in Table 1. Sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea solution (T5) showed higher contents of CP, EE, sodium and potassium compared to T2, T3 and T4. On the other hand, the lowest values of CP, EE, GE, sodium and potassium were recorded by T2, while alfalfa (T1) had the highest values of CP, NFE, GE, sodium and potassium compared with the four treatments. The improvement in sprouted mixtures may be attributed to increase the activity of sprouted barley seed hydrolytic enzymes which catabolized starch to soluble sugars for use in respiration and cell-wall synthesis during the germination and early stage of plant growing and lead to improvements in chemical composition of sprouted barley grains on olive cake and rice straw (Chavan and Kadam, 1989).

Table (1): Chemical composition of the experimental diets.

Item	Experimental diets				
	T1	T2	T3	T4	T5
Chemical composition, % of DM					
Organic matter	83.79	84.64	83.92	84.30	83.63
Crude protein	13.85	7.93	9.96	10.24	11.27
Crude fat	2.51	2.20	2.35	2.52	2.67
Nitrogen free extract	42.88	40.86	40.31	41.04	39.96
Neutral detergent fiber	45.00	68.42	67.09	64.19	63.40
Acid detergent fiber	32.00	41.40	40.74	39.56	37.07
Acid detergent lignin	10.33	16.43	15.43	13.40	12.13
Cellulose	21.67	24.97	25.31	26.16	24.94
Hemicellulose	13.00	27.02	26.35	24.63	26.33
GE Mcal/kg DM[1]	381.68	374.70	375.55	378.44	377.99
Sodium	0.430	0.186	0.196	0.210	0.220
Potassium	0.606	0.156	0.166	0.176	0.180

T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea. GE (Mcal/kg DM) =CP×5.65+CF×4.15+EE×9.40+NFE×4.15 Blaxter (1968).

In this connections, during germination occur some biochemical changes such as DM and starch content decrease and CP, CF, ash contents increase. Also carbohydrates were assimilated for metabolic activity during germination. The metabolic energy is used for growth and development with this biochemical process. Because the dry matter could not be substituted by the photosynthesis, sprout weight is decreased by the time photosynthesis accelerate (Anonim, 2011). Additionally, β-amylase activity that hydrolyzes the starch into simple carbohydrate was increased (Suda *et al*., 1986). Starch in cotyledon was broken down into smaller molecules such as glucose and fructose to provide energy for cell division while the seeds mature and grow (Vidal-Valverde *et al*., 2002 and Nonogaki *et al*., 2010). Researchers in many ways reported that DM content of the seeds is decreased while CP content increased during the sprouting (Tudor *et al*., 2003; Fayed, 2011; Fazeli *et al*., 2012; Helal, 2012 and 2015).

Voluntary feed intake, mineral intake and water consumption rate:

Dry matter intake, crude protein intake (Kg), minerals intake (g/kg BW), water consumption (ml/kg BW) and body weight (kg) are presented in Table (2) and Figure (1). Goats fed on T5 recoded the highest (P≤0.05) values of DMI (44.82 g/kg BW) followed by T4, T1, T3 and T2 in descending order, the highest values of DMI due to the higher palatability for sprouted barley grains on 50% rice straw+50% olive cake treated with urea solution compared with control group.

Table (2): Nutrients intake by goats fed the experimental diets.

Item	Treatments						
	T1	T2	T3	T4	T5	SEM	Sig.
Intake, g/kg BW							
Dry matter	41.71[abc]	38.92[c]	40.94[bc]	42.34[ab]	44.82[a]	0.973	*
Crude protein	5.77[a]	4.03[c]	4.07[c]	4.34[c]	5.05[b]	0.124	**
Sodium	0.156[a]	0.080[c]	0.090[bc]	0.093[bc]	0.096[b]	0.004	**
Potassium	0.223[a]	0.066[b]	0.076[b]	0.076[b]	0.076[b]	0.004	**
Water consumption (ml/kg BW)	180.79	167.50	171.73	162.73	168.42	8.675	ns
Body weight (kg)							
Initial	24.50	24.00	24.00	24.50	24.70	1.290	ns
Final	26.50	25.23	25.50	26.20	26.60	0.571	ns
BW changes	2.00	1.23	1.50	1.70	1.90	0.667	ns

*T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea. * P≤0.05, ** P≤0.01, ns: non-significant; a,b,c Means with different superscripts in the same raw are significantly different at (P≤0.05) or (P≤0.01).*

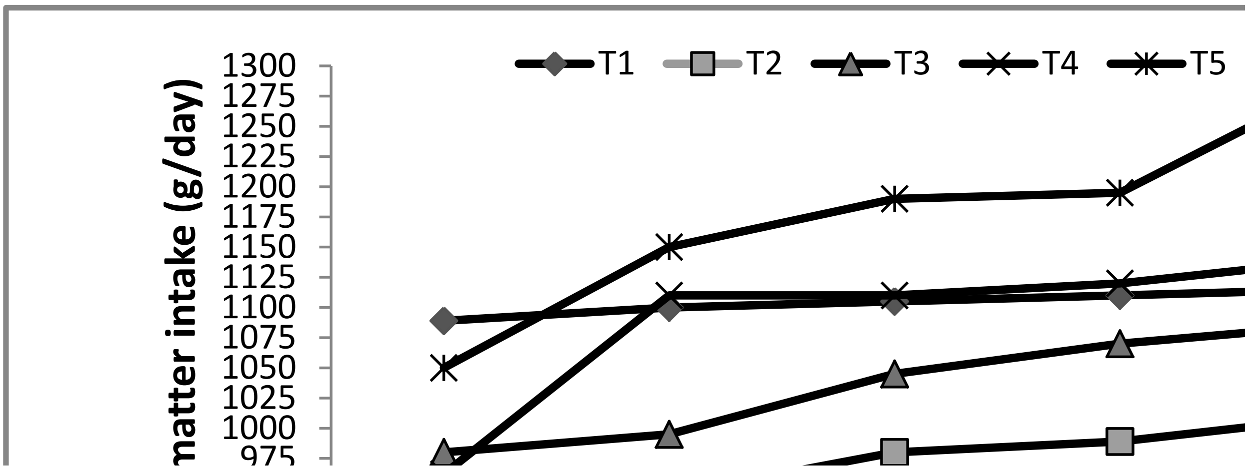

Figure (1). Dry matter development of goats fed experimental diet

T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea.

These results were agreement with Eshtayeh (2004) who found that highest DM intake detected by awassi ewes fed barley hydroponic fodder; the same trend was reported by Fazeli et al. (2011) who showed that male calves fed 22.8% barley hydroponic fodder supplement in their daily ration could be due to the high palatability of barley hydroponic fodder, in addition Gunun et al. (2013) indicated that urea treated straw was highly palatable, the increase in palatability might be due to the blending and processing of less palatable fibrous straw (Jaglan and Kishore, 2005), which may partially explain our observed increase in DM and nutrient intake. CP intake g/kg BW was significantly (P≤0.01) high in animals fed T1 followed by those fed T5 and the lowest was T2, respectively. This finding related to the high content of CP in Alfalfa. The lowest significant of water consumption was recorded by goats fed T4 (162.73 ml/kg BW) as compared with other treatments, the reduction in water consumption may be due to the animal's water recovery potential from the sprouted green fodder. These results were agreement with Fazeli et al. (2011) and Weldegerima (2015). Minerals intake g/kg BW was summarized in table 2. Sodium and Potassium are mainly involved in maintenance of osmotic pressure and acid balance in the body (McDowell, 1997).This greatest concentrations of Sodium and Potassium intake g/kg BW were reported in alfalfa followed by T5 and the lowest was T2. These results were agreement with Mbaeyi and Onweluzo (2010) who showed significant increase (P≤0.05) in phosphorus, sodium and potassium content of sprouted samples.

Nutrient digestion coefficients and Nitrogen balance:

Digestibility coefficients, nutritive values and nitrogen balance are shown in Table 3. Goats fed T5 recorded the highest (P≤0.01) digestibility coefficients of EE, NDF and hemicellulose compared with other groups. Highest digestibility coefficients of CP was recorded by animals fed T1 and T5 being 75.06 and 73.49%; respectively with no significantly differences between T3 and T4, while the lowest (P≤0.05) digestibility coefficients of CP was recorded by T2. These results agree with that obtained by Fayed (2011), Helal (2012), Helal and Mona (2013a), Helal and Mona (2013b) and Helal (2015) who found that the digestibility coefficients of all nutrients for sprouted barley on tested roughages were higher than that of untreated. This may be attributed to fresh grains sprouts have been reported to have highly soluble protein and amino acids in response to the enzymatic transformations during early plant growth (Chung *et al*., 1989 and Dikshit and Ghadle, 2003).

Table (3): Digestibility coefficient, nutritive values and nitrogen balance of the experimental diets.

Item	Treatments						
	T1	T2	T3	T4	T5	SEM	Sig.
Nutrient digestibility (%)							
Dry matter	63.31	59.46	63.65	68.85	69.03	1.631	ns
Organic matter	66.31	59.78	64.00	68.39	70.52	1.654	ns
Crude protein	75.06[a]	65.14[b]	68.83[ab]	71.39[ab]	73.49[ab]	1.376	*
Either extract	56.23[c]	64.92[b]	66.45[b]	68.39[ab]	73.98[a]	1.685	**
Nitrogen free extract	71.46[a]	55.58[b]	59.48[b]	66.14[ab]	66.19[ab]	1.930	**
Neutral detergent fiber	57.48[b]	60.84[ab]	60.91[ab]	69.97[ab]	73.65[a]	2.218	**
Acid detergent fiber	63.35	62.50	64.05	69.22	69.80	1.635	ns
Hemicellulose	43.04[c]	54.43[bc]	61.16[abc]	71.12[ab]	79.55[a]	4.121	**
Nutritive values%							
TDN	57.32	49.29	51.43	53.65	58.55	2.009	ns
DCP	9.24[a]	6.52[c]	7.09[c]	7.22[c]	8.24[b]	0.281	**
Nitrogen utilization (mg/kg/BW)							
N-intake	1175.27[a]	950.07[b]	953.80[b]	1071.42[ab]	1119.08[a]	41.847	**
Fecal-N	216.03[b]	402.73[a]	346.25[ab]	222.21[b]	195.34[b]	48.131	**
Urinary-N	268.10[a]	253.64[a]	209.35[ab]	154.24[bc]	124.33[c]	18.719	**
N-balance	691.14[a]	293.70[b]	398.20[b]	694.97[a]	799.41[a]	76.722	**

*T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea. * P≤0.05, ** P≤0.01, ns: non-significant; a, b,c Means with different superscripts in the same raw are significantly different at (P≤0.05) or (P≤0.01)***.**

Moreover, Abbase (2009) reported that vegetated barley is rich in β-gluconase enzymes which led to hydrolysis of carbohydrates complex to simpler nutrients. Also, there was an increase in OM digestibility for T3, T4 and T5 by 63.65, 68.85 and 69.03% respectively, compared with Alfalfa diet. While, there were no significant differences in the OM digestibility among the five experimental groups. This could be explained on the basis that vegetation process improved the digestibility and nutritive values of rice straw as bedding material Abbase (2009). In this respect, Gunun *et al*. (2013) who reported that 3% urea-treated rice straw (UTRS) could improve digestibility of DM, OM, and CP, which may have been due to the higher CP content in the UTRS and enhanced CP intake. Also, Shoukry *et al*. (1993) and Yacoyt *et al*. (2007) reported that urea treatment of poor quality roughages increased digestibility or degradability of cell wall constituents. Moreover, NDF and ADF digestibility was higher for UTRS than for RS. Resulting in an increased surface area available for attack by rumen microorganisms and thus increasing the rate of breakdown and the rate of passage of treated straw through the digestive tract (Goto and Yokoe, 1996 and Ha *et al*., 2001).

Nutritive values expressed as TDN% and DCP%; the highest TDN% value was recorded by animals fed T5 (58.55%) followed by T1, T4, T3 and the lowest value was for T2. Highest ($P \leq 0.01$) DCP% was 9.24% which recorded by T1 followed by T5, T4, T3 and T2, respectively. These results may be attributed to higher CP digestibility coefficients of animals fed T1 and T5. It also could be due to the improvement of nutrient quality, because of the ability of sprouted germinated plants to transport nutrients to the roots to meet the requirement for strong healthy vegetative growth, besides increasing protein, vitamins and minerals content during process (Shipared, 2005 and Dung *et al*., 2010).

Data of N-balance recorded for the five experimental groups are reported in Table 3. Higher values of nitrogen intake were recorded by T1 (1175.27) followed by T5 (1119.08) and T4 (1071.42) with insignificant differences. Higher nitrogen intake may due to high content of crude protein in T1, T4 and T5 (Table 1). Lowest ($P \leq 0.01$) values of fecal nitrogen and urinary nitrogen were recorded by T5 being 195.34 and 124.33 (mg/kg/BW); respectively compared with other groups. Animals fed the T5 and T4 recorded highest significantly ($P \leq 0.01$) of N balance compared with other groups. This finding may be related to higher improvement in CP intake and its digestibility in sprouted mixtures compared with other experimental forages. The highest nitrogen retention by feeding urea treatment could be due to the higher improvement in CP intake and digestibility and the higher utilization of urea nitrogen by goats. Therefore, these treatments improve also the intake, digestibility, feeding value and N-balance (Hassan, 2005).

Minerals utilization:

Data of Table (4) showed that Sodium and Potassium utilization revealed that Na intake, excretion and balance (g/kg BW) were varied significantly among the experimental groups. The highest ($P \leq 0.01$) values of Na and K intake and excretion in urine were for T1. Highest ($P \leq 0.05$) value of Na balance was recorded by group fed T5; however, there were insignificant differences in K balance (g/kg BW) between the five experimental groups. Generally, increasing metabolic enzymes of sprouting release more minerals from their bound complexes with anti-nutrient (Obizoba and Egbuna, 1991 and Nnam, 2000); thus, sprouting increased the levels of the minerals in the treated samples. Also, Morgan *et al.* (1992) found that ash content of sprouts increased from 2.1 in original seed (barley) to 5.3 at 8 day with increasing trace minerals.

Table (4): Sodium and Potassium (g/kg/BW) utilizations for goats fed the experimental diets.

Item	Diets					SEM	Sig.
	T1	T2	T3	T4	T5		
Sodium							
Na-intake	0.255^{a}	0.093^{b}	0.118^{c}	0.131^{d}	0.141^{e}	0.002	**
Excretion in feces	0.021^{c}	0.044^{a}	0.042^{ab}	0.030^{abc}	0.028^{bc}	0.004	*
Excretion in urine	0.226^{a}	0.041^{c}	0.062^{b}	0.075^{b}	0.081^{b}	0.006	**
Na-balance	0.008^{b}	0.008^{b}	0.014^{ab}	0.026^{ab}	0.032^{a}	0.007	*
Potassium							
K-intake	0.359^{a}	0.082^{c}	0.087^{bc}	0.094^{bc}	0.102^{b}	0.005	**
Excretion in feces	0.019	0.033	0.027	0.025	0.014	0.005	ns
Excretion in urine	0.335^{a}	0.045^{c}	0.051^{c}	0.054^{c}	0.070^{b}	0.003	**
K-balance	0.005	0.004	0.009	0.015	0.018	0.005	ns

*T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea. * P≤0.05, ** P≤0.01, ns: non-significant; a,b,c Means with different superscripts in the same raw are significantly different at (P≤0.05) or (P≤0.01).*

Rumen parameters:

Data of rumen pH, total volatile fatty acids (TVFA, s) and ammonia-nitrogen are presented in Table 5. It was clear that goats fed T5 recorded the highest significant pH value compared to the other experimental groups. The highest value of pH was obtained before feeding compared to time of post feeding. One of the most important factors influencing rumen pH is the amount of saliva buffer secretion, which is positively correlated with rumination activity Lu *et al.* (2005). Moreover, Van Soest (1994) reported that cellulolytic organisms grow optimally at pH 6.7 and pH below 6.2 inhibited the rate of digestion, decreased acetic acid and depressed cellulolytic activity. Rumen total volatile fatty acids (TVFA, s) revealed that supplemented sprouted media with 3% urea increased ($P\leq0.01$) TVFA, s concentrations in the rumen, which increased after feeding and reaches its peak after 3 hours post feeding (11.74meq/100ml). Animals fed on T5 recorded the highest value of total volatile fatty acids concentrations; it might be a reflection to rich energy and organic matter of fodder fed to small ruminants that provided higher concentrations of rumen metabolites which naturally improved rumen function and digestibility (Bonsi *et al.*, 1995). The increase in TVFA, s concentration in animals fed sprouted barley may be due to that sprouts provide a good supply of vitamins, enzymes which serve as bioactive catalysts to assist in metabolism of feed and the release of energy (Shipard, 2005). In addition, Opera *et al.* (1975) reported that N supplementation from urea could increase the activity of rumen microbes in degrading carbohydrates (cellulose and starch) for TVFA, s production when the energy level was sufficient. These results were in accordance with those obtained by Abd EL-Nabi (2007) and Helal (2012 and 2015) who reported that dietary sprouted barley mixture increase TVFA, s in sheep rumen. Goats fed T5 recorded the highest ($P\leq0.01$) ammonia-nitrogen compared with other experimental groups. The highest values of ammonia-nitrogen were 40.79 mg/100ml post feeding with 3 hours. This is may be due to its high content of CP and highest CP intake for animals fed this group **(**Norton, 2003). Other researchers reported an increase in rumen ammonia N with increase in CP supplementation (Bohnert *et al*., 2002 and Salisbury *et al.*, 2004). Moreover, Highstreet *et al*., (2010) reported that higher ruminal NH3-N concentration occurred when steers were fed urea treated rice straw because of the relatively high levels of soluble CP which would likely have caused higher rumen ammonia levels particularly immediately after feeding.

Table (5). Ruminal fermentation parameters for goats fed the experimental diets

Item	Time	Treatments					SEM	Sig.
		T1	T2	T3	T4	T5		
pH								
	0	6.78^{a}	6.55^{b}	6.64^{ab}	6.69^{ab}	6.82^{a}	0.064	*
	3	6.01^{d}	6.09^{c}	6.13^{c}	6.19^{b}	6.28^{a}	0.018	**
	6	6.40	6.22	6.27	6.32	6.40	0.056	ns
TVFA, s								
	0	5.53	4.78	5.10	5.27	6.14	0.520	ns
	3	10.12^{bc}	8.89^{c}	9.18^{bc}	10.65^{ab}	11.74^{a}	0.485	**
	6	8.62^{b}	6.98^{c}	7.84^{bc}	8.86^{ab}	9.82^{a}	0.329	**
NH3-N								
	0	22.40^{c}	22.90^{bc}	25.64^{ab}	26.52^{a}	27.75^{a}	0.921	**
	3	39.77^{b}	36.03^{d}	38.09^{c}	39.82^{b}	40.79^{a}	0.281	**
	6	34.10^{b}	31.78^{c}	32.70^{c}	34.03^{b}	35.54^{a}	0.321	**

*T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea. * $P\leq0.05$, ** $P\leq0.01$, ns: non-significant; a,b,c Means with different superscripts in the same raw are significantly different at ($P\leq0.05$) or ($P\leq0.01$).*

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Data of serum constituents of studied goats as affected by sprouting barley seeds on studied mixtures are given in Table 6. Total protein (g/dl), creatinine (mg/dl), albumin (g/dl), globulin (g/dl) and Serum urea-N were significantly ($P\leq0.01$) elevated by treatments. Goats fed T5 increased ($P\leq0.01$) serum total proteins, albumin, creatinine and Serum urea-N compared with other experimental groups. The highest level of globulin by sprouted barely treatments may indicate good developed immunity status (Ibrahim *et al*., 2001). This is in accordance with those reported by Kumar *et al.* (1980) who found a positive correlation between dietary protein and plasma protein concentration. Also, means of serum creatinine increased ($P\leq0.01$) with T5. This was probably due to the high level of CP content in T5. These results are in harmony with those reported by Fayed (2011) and Helal (2012). Additionally, Elisabetta *et al.*

(2009) introduced integration with hydroponically germinating oat in partial substitution of the complete feed does not modify biochemical and hematological parameters and seems to produce an improvement in animal. Generally, ruminal ammonia nitrogen (NH3-N) and blood urea nitrogen (BUN) were increased (P<0.01) by urea treatment (Gunun *et al*., 2013).

Table (6): Blood parameter for goats fed the experimental diets.

Item	Treatments					SEM	Sig.
	T1	T2	T3	T4	T5		
Total protein g/d	7.65^{a}	6.20^{c}	6.67^{b}	7.36^{a}	7.53^{a}	0.150	**
Albumin g/d	3.41^{abc}	3.19^{c}	3.28^{bc}	3.48^{ab}	3.62^{a}	0.070	**
Globulin g/d	4.24^{a}	3.01^{c}	3.39^{bc}	3.88^{ab}	3.91^{ab}	0.189	**
Urea mg/d	33.45^{b}	32.20^{c}	32.90^{bc}	33.75^{ab}	34.69^{a}	0.354	**
Creatinine mg/d	1.33^{b}	1.17^{c}	1.21^{c}	1.32^{b}	1.43^{a}	0.015	**

*T1: Alfalfa (Medicago sativa) (control), T2: sprouted barley grains on 50% rice straw+50% olive cake, T3: sprouted barley grains on 50% rice straw+50% olive cake treated with 1% urea, T4: sprouted barley grains on 50% rice straw+50% olive cake treated with 2% urea, T5: sprouted barley grains on 50% rice straw+50% olive cake treated with 3% urea. * P≤0.05, ** P≤0.01, ns: non-significant; a,b,c Means with different superscripts in the same raw are significantly different at (P≤0.05) or (P≤0.01).*

CONCLUSION

From the results of the present study, goats could be fed on sprouted barley grains on agricultural by-products (rice straw) and agro-industrial by-products (olive cake) treated with urea solution, without any bad effect on feed utilization.

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تأثير تغذية حبوب الشعير المستنبت علي قش الارز وفلة الزيتون علي اداء الماعز في سيناء

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قسم تغذية الحيوان والدواجن- مركز بحوث الصحراء- المطرية- مصر.

تهدف الدراسة الحالية الى دراسة تأثير استنبات حبوب الشعيرعلى مخلوط من تفلة الزيتون وقش الارز الجاف بنسبة (50:50) غيرمعامل (معاملة 2) اومعامل بثلاث مستويات مختلفة من محلول اليوريا 1% (معاملة 3)، 2% (معاملة4) او 3% (معاملة 5) مقارنة بمجموعة الكنترول (البرسيم الحجازي) تم تغذية كل المعاملات التجريبية للشبع لمدة 45 يوم واستخدم في هذا البحث عدد 20 ذكر ماعز صحراوي بمتوسط وزن البداية 24 كجم عمر حوالي 18 شهر وتم تقسيمهم عشوائيا الى خمس مجموعات (4حيوانات بكل معاملة) وتم استخدامهم في تجربة تغذية استمرت 45 يوم ثم تجربة هضم (15يوم). اوضحت ننتائج الدراسة ان انبات حبوب الشعيرعلي المخلوط المعامل بمحلول اليوريا ادي الى زيادة البروتين الخام وانخفاض المادة العضوية ومكونات الالياف مع تحسن معنوي في زيادة استهلاك الغذاء كمادة جافة. سجلت الماعز المغذاه علي مستنبت حبوب الشعيرعلي المخلوط المعامل بمحلول اليوريا بنسبة 3% الى تحسن معنوي في معاملات هضم كل من البروتين الخام، مستخلص الاثير، مكونات الالياف والمركبات الكلية المهضومة حيث كانت اعلي قيمة للمجموعة الخامسة (58,55%) ثم الاولي والرابعة والثالثة وكانت اقلهم المجموعة الرابعة كما تحسنت قيم البروتين الخام معنويا حيث كانت اعلي قيمة للمعاملة الاولي (المقارنة) ثم الخامسة والرابعة والثالثة والثانية علي التوالي. كان ميزان النيتروجين موجب في كل المعاملات التجريبية وكان اقل نيتروجين محتجز في المعاملة الثانية والمغذاه علي المخلوط الغير معامل بمحلول اليوريا مقارنة بباقي المعاملات التجريبية. زاد تركيز الاحماض الدهنية الطيارة والامونيا معنويا بالكرش بعد 3 ساعات من التغذية نتيجة للمعاملات فكانت اعلي قيمة في المجموعة الخامسة والرابعة ثم الاولي. نستخلص من هذه الدراسة ان تغذية الماعز الصحراوي علي مخلوط تفلة الزيتون وقش الارز الجاف بنسبة (50:50) المستنبت عليه حبوب الشعيربنسبة 15% والمعامل بمحلول اليوريا بنسبة 3% سجل اعلي القيم الغذائية من حيث المركبات المهضومة الكلية والبروتين الخام المهضوم وميزان النتروجين دون تاثر مكونات الدم.