J. Animal and Poultry Prod., Mansoura Univ., Vol. 2 (6): *201 - 215, 2011*

UTILIZATION OF NEW NUTRITIONAL RESOURCES IN RUMINANT FEEDING:
2) EFFECT OF USING DRIED DISTILLERS GRAINS WITH SOLUBLE (DDGS) AS PROTEIN SOURCE IN RATIONS FOR FATTENING BUFFALO CALVES

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ABSTRACT

The present work was carried out to study the effect of using dried distillers grains with soluble (DDGS) as a source of protein in ration formulation of buffalo calves. DDGS was included in concentrate feed mixture (CFM) at 0, 11, 16, 21 and 27% to cover 0, 20, 30, 40 and 50% of total protein, respectively.

Fifty male buffalo calves averaging 320.16 kg live body weight were randomly distributed into five similar groups (10 in each) and assigned to receive five concentrate feed mixtures containing five levels of DDGS. Animals were fed CFM along with berseem hay and wheat straw at the ratios of 70: 20: 10, respectively. The feeding trail lasted 184 days, during which, five digestibility trials were carried out to determine the digestibility and feeding values of the experimental rations. In addition, samples of rumen liquor and blood serum were taken to determine some ruminal and blood parameters. Also, feed and economical efficiencies were studied.

The results showed that:

1- Digestibility coefficients were significantly (P<0.05) higher in DM, OM, CP and CF with animals fed rations containing DDGS. Nutritive values expressed as TDN (%), DCP (%) and DE (Mcal/Kg DM) were significantly higher (P<0.05) for ration E (containing 27% DDGS) than the other rations.
2- Animals fed ration E (containing 27% DDGS) showed the highest TDN (77.03%) DCP (12.49%) and DE (3.40 Mcal/Kg DM) versus 65.67%, 11.00% and 2.89 Mcal/Kg DM for animals fed control ration. However, all experimental rations (containing DDGS) appeared to higher nutritive values than that of control ration.
3- The highest daily gain (1.170 Kg) was recorded with animals given ration E, which had 31.46% extra improvement and increase in weight gain. Also, animals fed experimental rations (B, C, D and E rations) tended to have better feed efficiency, showing the best feed utilization efficiency expressed as DM, TDN or DCP per Kg gain being 11.147, 8.586 and 1.392 Kg/Kg gain, respectively, for animals fed ration E.
4- Animals fed ration E (containing 27% DDGS) appeared to have the lowest feed cost/Kg weight gain (17.837 LE).The highest economical efficiency (1.233) versus the highest feed cost and lowest economical efficiency was observed with animals fed control ration (ration A).
5- All ruminal and blood serum parameters were within the normal values, showing that added DDGS in ration formulation of fattening buffalo calves had no adverse effects on serum parameters and led to get better performance of animals.

Generally, it may be concluded that, the inclusion DDGS at 27% to cover 50% of total protein of concentrate feed mixture in fattening buffalo calves rations tended to produce better nutrient digestibility and feeding values. Moreover, animals fed rations containing DDGS had higher weight gains and lower feed cost with the best economical efficiency without any adverse effects on ruminal or blood serum parameters.

Keywords :DDGS, rumen fermentation, blood constituents.

INTRODUCTION

Energy and protein sources are the two most important factors that play a big role in affecting animal production and its performance. Dried distiller grains with soluble (DDGS) is a co-product of ethanol industry which is high in both energy and protein (Etman *et al.,* 2010). It is an excellent energy and protein source for beef cattle in all phases of production. It can effectively be used as an energy source and be fed up to 40% of ration dry matter for finishing cattle with excellent growth performance and carcass and meat quality (Roeber *et al.,* 2005). In addition, this product have been used in many trials as source of energy or protein in ration formulation of dairy animals, beef steers, heifers, sheep, poultry and swine (May *et al.,* 2009; Leupp *et al.,* 2009 and Reed *et al.,* 2006). However, at this high level feeding (40%) DDGS excess protein and phosphorus are fed to animals.

The best application for using DDGS in beef cattle diets are in situations where: 1) supplemental protein is needed (especially when feeding poor quality roughages) to replace corn gluten feed or soybean meal, 2) a low starch, high fiber energy source is needed to replace corn gluten feed or soy bulls and 3) when a source of supplemental fat is needed (Bremer *et al.,* 2005; Ham *et al.,* 1994; Loy *et al.,* 2004 and Vander Pol *et al.,* 2005).

This study aimed at examining the proper levels of DDGS inclusion in the concentrate feed mixture including for fattening buffalo calves. Digestibility coefficients and nutritive values of tested rations containing DDGS were determined. Moreover, animal performance, feed conversion and economical efficiency were studied and some ruminal and blood parameters were measured.

MATERIALS AND METHODS

Fifty male buffalo calves averaging 320.16Kg L.B.W. were used in this trial, during summer 2009 at Farm of Sharkeia National Company for food security, Sharkeia governorate, Egypt. Animals were randomly chosen and divided into five similar groups (10 in each) according to body weight and age. All animals were assigned to receive experimental rations containing concentrate feed mixture, berseem hay and wheat straw with rate of 70: 20: 10, respectively, according to Shehata allowances (1972).

The trial aimed to use DDGS (dried distiller grains with soluble) as a partial substitute for other protein sources and as a new feed ingredient in the concentrate feed mixture . DDGS was included in CFM to replace its protein content at the rate of 0, 20, 30, 40 and 50% of total protein . The concentrate feed mixture was offered to animals twice daily at 8.00 a.m. and 4.00 p.m. followed by berseem hay, while wheat straw and water were available during the whole day. The feeding trial lasted 184 days, in which, changes of body weight and feed intake were recorded at two weeks intervals. At the middle of the feeding trial, fifteen calves were chosen (3 from each group) to determine digestion coefficients and nutritive value for different experimental rations using acid insoluble ash technique (AIA) as a natural marker according to Van Keulen and Young (1977).

Representative samples of concentrate feed mixture, berseem hay, wheat straw and feces were chemically analyzed according to A.O.A.C. (2000). Digestion coefficients of all nutrients were calculated according to Schneider and Flatt (1975), where: DM digestibility (%) 100-[100x (AIA% in feed/AIA % in feces)], Nutrient digestibility (%) = 100 – [100 x (AIA% in feed/AIA% in feces)(nutrient % in feces/nutrient% in feed)].

During the digestibility trials, rumen liquor samples were taken from the same animals belonging to digestibility trials at zero time (before morning feeding), 3 and 6 hours after feeding using stomach tube. After preparing rumen samples, each sample was divided into two parts, the 1st to determine the pH value using Orian 680 digital pH meter, and the 2nd part was preserved in dry clean glass bottles with addition 2 drops of mercuric chloride to determine total-N, protein-N and ammonia-N concentrations according to A.O.A.C. (2000), while total VFA's concentration were determined according to Eadie *et al.* (1967).

Blood samples were taken from the jugular vein of the same previous animals of digestibility trials (3 hrs post feeding). Blood samples were centrifuged for 15 minutes at 4000 r.p.m. Serum was separated from blood and kept it in frozen at -20^{o}C for chemical analysis to determine total protein (Cornell *et al.,* 1949), albumin (Drupt, 1974), while globulin concentration was determined by differences between total protein and albumin concentrations. Creatinin concentration was determined according to Young (1990). The AST and ALT activities were determined as described by Reitman and Frankel (1957). Urea concentration was determined according to Fawcett and Scott (1960).

Data were statistically analyzed by using GLM program of the Statistical Analysis System (SAS, 1996). The differences among means were tested using Duncan Multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Effect of adding DDGS on chemical composition of concentrate feed mixture:

Data presented in Table (1) showed the different ingredients of concentrate feed mixture (CFM) including the different levels of dried distiller grains with soluble (DDGS).

The DDGS were included at 0, 11, 16, 21 and 27% in concentrate feed mixture of A, B, C, D and E experimental rations, respectively to replace 0, 20, 30, 40 and 50% of the protein content, respectively. It could be noticed that, DDGS has been used to replace soybean meal and glutofeed. Also, it could be seen that, soybean meal contributed one half of the CP content in CFM of rations B and C compared to control ration (ration A), while it was absent in CFM of rations D and E.

Table (1): Ingredients of concentrate feed mixtures containing different levels of DDGS in experimental rations.

Items	*CFM of experimental rations				
	A	B	C	D	E
Ingredients (%):					
Yellow corn	47	44	44	40	40
Glutofeed (16%)	30	27	22	26	20
**DDGS	--	11	16	21	27
Soybean Meal (44%)	10	5	5	--	--
Rice bran	5	5	5	5	5
Wheat bran	5	5	5	5	5
Limestone	2	2	2	2	2
Salt	1	1	1	1	1

*** CFM: Concentrate feed mixture.**
**** DDGS: Dried distillers grains with soluble.**

The chemical composition of different CFM including different levels from DDGS are shown in Table (2) along with the other components of experimental rations. Most nutrients of different CFM were similar and somewhat higher percentages of CP, EE, CF and OM contents and somewhat lower percentage of NFE and ash contents were recorded with increasing the levels of DDGS.

The chemical analysis showed that, the nutrient contents of berseem hay, wheat straw and DDGS were similar with those reported by Etman *et al.* (2010).

Table (2): Chemical composition of concentrate feed mixtures containing different levels of DDGS, berseem hay and wheat straw.

Items	DM (%)	Composition of DM (%)					OM (%)
		CP	EE	CF	NFE	Ash	
Berseem hay	91.80	15.60	2.94	25.42	46.64	9.40	90.60
Wheat straw	91.28	3.20	1.50	42.10	43.06	10.14	89.86
*DDGS	91.10	26.70	7.52	8.74	52.64	4.40	95.60
** CFM including 0% DDGS	88.41	14.21	4.90	5.52	71.38	3.99	96.01
CFM including 11% DDGS	88.46	14.24	5.33	5.78	70.72	3.93	96.07
CFM including 16% DDGS	88.45	14.77	5.35	5.79	70.24	3.85	96.15
CFM including 21% DDGS	88.51	14.84	5.78	6.13	69.43	3.82	96.18
CFM including 27% DDGS	88.51	14.87	5.81	6.14	69.38	3.80	96.20

*** DDGS: Dried distillers grains with soluble.**
**** CFM: Concentrate feed mixture.**

Effect of Feeding DDGS on Daily Feed intake and Nutrients Digestibility :

Results obtained in Table (3) showed that there were gradual increase in daily feed intake in terms of both Kg DM/head and gm DM/$W^{0.75}$ with increasing DDGS levels in rations. The trend was observed with calculated composition of experimental rations, especially CP content, while the other nutrients were not affected by increasing levels of DDGS. The increasing of CP content in ration E was associated with the decrease OM, EE and NFE contents.

Data obtained revealed that, digestibility coefficients of DM, OM, CP and NFE for ration E were significantly (P<0.05) higher than those found with rations A and B. Increasing DDGS level up to 27% in ration E appeared to significantly increase the digestibility of most nutrients, while increasing DDGS from 11% to 16% or from 21% to 27% in experimental rations did not have significant effect on nutrient digestibility. These results showed that, incorporation of DDGS in CFM of experimental rations at the rate of 21% or 27% tended to significantly increase most of nutrient digestibility. However, the inclusion of DDGS at the rate of 11% or 16% significantly decreased nutrient digestibility.

Table (3): Average daily feed intake, calculate composition, digestibility coefficients and nutritive values of different experimental rations.

Items	Experimental rations					Significant levels
	A	B	C	D	E	
AV. Daily feed intake (Kg DM/Head):						
Concentrate feed mixture	8.478	8.490	8.715	8.890	9.158	
Berseem hay	2.422	2.450	2.490	2.542	2.588	
Wheat straw	1.210	1.186	1.195	1.155	1.296	
Total DM intake	12.110	12.126	12.400	12.587	13.042	
AV. Daily feed intake (gm DM/Kg $W^{0.75}$):						
Concentrate feed mixture	94.43	94.10	94.79	95.34	96.76	
Berseem hay	26.98	27.19	27.08	27.26	27.34	
Wheat straw	13.48	13.16	12.99	12.39	13.69	
Total DM intake	134.89	134.45	134.86	134.99	137.79	
Calculate composition of experimental rations:						
DM	89.38	89.41	89.40	89.45	89.46	
OM	94.32	94.36	94.42	94.37	94.03	
CP	13.39	13.41	13.78	13.82	13.85	
EE	4.17	4.47	4.49	4.79	4.41	
CF	13.15	13.34	13.34	13.58	13.58	
NFE	63.61	63.14	62.81	62.18	62.19	
Digestibility Coefficients of experimental rations:						
DM	72.15^{b}	75.52^{b}	75.18^{ab}	78.32^{a}	80.11^{a}	(P<0.05)
OM	80.40^{b}	82.16^{b}	82.84^{ab}	84.17^{a}	85.14^{a}	(P<0.05)
CP	82.16^{c}	86.42^{b}	86.84^{a}	89.12^{a}	90.18^{a}	(P<0.05)
EE	90.14	90.17	91.22	90.32	90.15	NS
CF	74.82^{c}	77.24^{b}	78.11^{b}	81.11^{a}	82.02^{a}	(P<0.05)
NFE	80.16	80.32	80.40	80.69	80.63	NS
Nutritive value:						
TDN (%)	65.67^{b}	68.80^{b}	70.96^{ab}	76.35^{a}	77.03^{a}	(P<0.05)
DCP (%)	11.00^{b}	11.59^{b}	11.97^{ab}	12.32^{a}	12.49^{a}	(P<0.05)
* DE (Mcal/Kg DM)	2.89^{b}	3.03^{b}	3.13^{ab}	3.37^{a}	3.40^{a}	(P<0.05)

a and b : Means in the same raw with different superscripts are significant (P<0.05) differed.

*** Calculated as mentioned by Pond *et al.,* (1995).**

However, all experimental rations containing DDGS had significantly ($P<0.05$) better nutrient digestibility as shown in Table (3). Similar trend was recorded for the nutritive values. Data showed that the TDN was 65.67, 68.80, 70.96, 76.35 and 77.03% for rations A, B, C, D and E, respectively. Corresponding values of DCP were 11.00, 11.59, 11.97, 12.32 and 12.49%, respectively, while DE (Mcal/Kg DM) were 2.89, 3.03, 3.13, 3.37 and 3.40 Mcal for respective rations. The present data demonstrated that, increasing DDGS levels up to 21% or 27% tended to significantly ($P<0.05$) increase TDN values compared with those obtained at the levels 11% or 16%. Similar trends were observed for DCP and DE. Improving and increasing digestibility coefficients and nutritive value of rations with increasing DDGS levels might be attributed to higher digestibility and availability of nutrient contents of DDGS as reported by Leupp *et al.* (2009) and May *et al.* (2009).

Generally, increasing DDGS levels of CFM up to 27% for experimental ration increased the CP content, digestibility coefficient and nutritive values of the rations. Therefore, DDGS could be used successfully to replace 50% of the protein content of CFM. These results were agreement with those reported by Bremer *et al.* (2005), Loza *et al.* (2004), Stock *et al.* (1999), Vander Pol *et al.* (2005) and Etman *et al.* (2010).

Effect of feeding DDGS on daily gain and feed utilization efficiency:

Data presented in Table (4) showed that average daily gains were 0.890, 0.915, 1.020, 1.108 and 1.224 Kg/head for animals fed rations A, B, C, D and E, respectively. Differences were highly significant ($P<0.05$) for ration E. Significant differences were not found between animals fed rations D & E and between those fed rations A & B. On the other hand, animals fed ration C had higher daily gains than those fed A and B rations and being lower than those fed rations D and E. However, there were no significant differences in daily gain between animals fed ration C and those fed the other different rations.

The present results showed that, incorporation of DDGS as an ingredient in the CFM at rates of 11, 16, 21, 27% in experimental rations tended to produce daily gains at rates of 2.81, 14.61, 24.49 and 31.46% for animals fed rations B,C, D and E, respectively. So, inclusion 27% DDGS as a source of protein in CFM instead of soybean and part of glutofeed appeared to produce significantly ($P<0.05$) higher daily gain and improved weight gain by 31.46%.

Higher daily gain of animals fed rations containing DDGS might be attributed to higher protein and energy content of DDGS along with its higher nutrient digestibility and available phosphorous as recorded by Al-Suwaiegh *et al.* (2002) who mentioned that steers fed diets containing wet distiller grains gained 10.1% faster and were 8.5% more efficient. Data in Table (4) showed also that daily feed intake from DM, TDN and DCP as Kg/head or Kg/w $^{0.75}$ increased with increasing DDGS levels in rations, indicating that the increase in body weight is a reflection of better digestibility and absorption of rations containing DDGS. These results were agreement with those reported by Ham *et al.* (1994), Firkins *et al.* (1985), Larson *et al.* (1993), Loza *et al.* (2004), Owens *et al.* (1997) and Etman *et al.* (2010).

Table (4): Averages daily, total gains and feed utilization efficiency of animals fed different experimental rations.

Items	Experimental rations					Significant levels
	A	B	C	D	E	
No. of animals	10	10	10	10	10	
Experimental period (day)	184	184	184	184	184	
Av. initial L.B.W. Kg	320.15	319.84	321.12	320.95	318.75	
Av. final L.B.W., Kg	483.91	488.20	508.80	524.82	533.97	
Av. total L.B.W. gain, Kg	163.76	168.36	187.68	203.87	215.22	
Av. daily L.B.W. gain, Kg	0.890[b]	0.915[b]	1.020[ab]	1.108[a]	1.170[a]	(P<0.05)
Improvement, (%)	--	2.81	14.61	24.49	31.46	
AV. Daily feed unite intake:						
Kg DM/head	12.110	12.126	12.400	12.587	13.042	
Kg TDN/head	7.953	8.343	8.799	9.610	10.046	
Kg DCP/head	1.332	1.405	1.484	1.551	1.629	
gm DM/$W^{0.75}$	134.885	134.554	134.871	134.981	137.792	
gm TDN/$W^{0.75}$	88.583	92.577	95.704	103.056	106.138	
gm DCP/$W^{0.75}$	14.836	15.590	16.141	16.633	17.211	
Feed utilization efficiency:						
Kg DM/Kg gain	13.607[a]	13.252[a]	12.157[ab]	11.360[b]	11.147[b]	(P<0.05)
Kg TDN/Kg gain	8.936	9.118	8.626	8.673	8.586	NS
Kg DCP/ Kg gain	1.497	1.536	1.455	1.400	1.392	NS

A and b : Means in the same raw with different superscripts are significant (P<0.05) differed.
NS: Not significant

The results obtained in Table (4) indicated also that the animals achieved better daily gains were also more efficient in feed utilization. Feed utilization efficiency expressed as Kg DM, TDN or DCP per Kg gain were 11.147, 8.586 and 1.392 Kg, respectively, with animals fed ration E (containing 27% DDGS), showing the group give diet E was to be the most efficient group.

There were no significant differences in feed efficiency as Kg TDN or DCP per Kg gain, while feed efficiency as Kg DM per Kg gain showed significant (P<0.05) improvement with animals fed rations D and E. the improvement of feed utilization efficiency were obvious with animals fed rations containing DDGS. This might be attributed to higher both final body weight and daily gains compared to those fed the control ration. Also, feeding 27% DDGS as an ingredient and source of protein and energy in ration formulation of buffalo calves appeared to achieve excellent growth rate and feed conversion. These results were agreement with those reported by Schingoethe (2004), Vander Pol *et al.* (2005), Reed *et al.* (2006), Bremer *et al.* (2005), Cooper *et al.* (2000) and Etman *et al.* (2010).

Effect of feeding DDGS on feed cost and economical efficiency:

Average daily feed intake as fed, feed cost and economical efficiency are presented in Table (5). It could be noticed that, increasing DDGS level in CFM tended to increase feed intake. Animals fed ration E (containing 27% DDGS) had the highest feed intake with the lowest feed cost, showing decreasing feed cost with increasing DDGS level in ration. Also, all animal groups fed different tested rations containing DDGS appeared to have lower feed cost compared to those fed the control ration. As a sequence of previous data, economical efficiency showed the same trend, being 0.887, 0.947, 1.034, 1.143 and 1.233 for animals fed rations, A, B, C, D and E, respectively. Moreover, the best animal group achieved the highest total and daily gain (animal group fed ration E containing 27% DDGS) showed the highest improvement (39.01%) in economical efficiency.

Table (5): Averages daily feed intake as fed, daily gain, feed cost and economical efficiency with different experimental rations.

Items	Experimental rations				
	A	B	C	D	E
AV. daily feed intake, as fed (Kg):					
Concentrate feed mixture	9.589	9.598	9.853	10.044	10.347
Berseem hay	2.638	2.669	2.712	2.769	2.819
Wheat straw	1.326	1.299	1.309	1.265	1.420
Av. daily L.B.W. gains (Kg)	0.890	0.915	1.020	1.108	1.224
Feed cost and economical efficiency:					
* Cost of feed consumed/head (LE)	22.054	21.246	21.692	21.326	21.833
Price of L.B.W. gain (LE)	19.580	20.130	22.440	24.376	26.928
Feed cost/Kg weight gain (LE)	24.780	23.220	21.267	19.247	17.837
Economical efficiency	0.887	0.947	1.034	1.143	1.233
Improvement (%)	--	6.76	16.57	28.86	39.01

*** Based on the assumption that the price of one ton of berseem hay, wheat straw, concentrate feed mixtures containing DDGS with rate of 0, 11, 16, 21 and 27% was 650, 80, 2110, 2022, 2012, 1934 and 1922 LE, respectively, and the price of one Kg body weight on selling was 22.00 L.E.**

Consequently, dried distiller grains with soluble (DDGS) can successfully replace more expensive sources of protein and energy in ration formulation of fattening buffalo calves. These results were agreement with those obtained by Leupp *et al.* (2009), May *et al.* (2009), Ham *et al.* (1994), Bremer *et al.* (2005) and Etman *et al.* (2010).

Effect of feeding DDGS on ruminal parameters:

Some ruminal parameters such as pH, VFA's, total nitrogen, ammonia-N, Protein and non-protein nitrogen concentrations are presented in Table (6). It could be noticed that, pH values significantly ($P<0.05$) increased by adding DDGS at 3 & 6 hrs after feeding. Concentrations of total VFA's appeared to significantly ($P<0.05$) higher with tested rations containing DDGS and at 6 hrs. after feeding. Other results revealed that the pH values were affected by level and/or the sources of both CP and carbohydrate as reported by Johnson and Sutton (1968), while VFA's concentrations in rumen liquor are affected by several factors such as DM digestibility, rate of absorption, rumen pH, transportation of the digesta from the rumen to the lower part of the digestive tract and microbial population in the rumen and their activities (Allam *et al.,* 1984). Also, higher total VFA's concentration with groups fed rations containing DDGS might be due to the increased apparent digestibility of organic matter (Arelovich *et al.,* 2000 and Shakweer *et al.,* 2010).

Table (6): Ruminal parameters of animals fed different experimental rations during sequent periods.

Items	Time of sampling (hrs)	Experimental rations					Significant Levels
		A	B	C	D	E	
pH value	0	6.40	6.42	6.51	6.56	6.58	NS
	3	6.12[b]	6.25[a]	6.32[a]	6.38[a]	6.43[a]	(P<0.05)
	6	6.45[b]	6.68[a]	6.75[a]	6.84[a]	6.85[a]	(P<0.05)
Total VFA's (meq/100ml)	0	10.82[c]	11.12[b]	11.86[b]	12.04[a]	12.81[a]	(P<0.05)
	3	9.86[c]	10.18[b]	10.04[b]	11.68[a]	11.24[a]	(P<0.05)
	6	10.28[b]	11.09[a]	11.47[a]	11.98[a]	12.64[a]	(P<0.05)
Total nitrogen (mg/100ml)	0	160.10	152.15	156.18	158.14	158.82	NS
	3	120.11[a]	108.16[b]	110.98[b]	115.29[a]	118.61[a]	(P<0.05)
	6	95.84[a]	85.17[b]	87.76[b]	92.15[a]	92.18[a]	(P<0.05)
NH_3-N (mg/100ml)	0	20.15[b]	22.18[a]	23.36[a]	23.74[a]	23.81[a]	(P<0.05)
	3	22.18[b]	25.15[a]	25.57[a]	26.29[a]	26.48[a]	(P<0.05)
	6	25.04[b]	28.64[a]	28.84[a]	29.16[a]	29.21[a]	(P<0.05)
Protein-N (mg/100ml)	0	116.50	107.15	109.84	110.82	108.11	NS
	3	82.18	84.64	84.84	85.19	85.25	NS
	6	64.25	63.52	65.14	66.45	66.19	NS
NPN (mg/100ml)	0	43.60	45.00	46.34	47.32	50.71	NS
	3	37.93[a]	23.52[c]	26.14[c]	30.10[b]	33.36[b]	(P<0.05)
	6	31.59[a]	21.65[c]	22.62[c]	25.70[b]	25.99[b]	(P<0.05)

a, b and c: Means in the same raw with different superscripts are significant (P<0.05) differed.
NS: Not significant

Total nitrogen concentrations in rumen liquar recorded the highest values at zero time, while the lowest values were recorded at 6 hrs. after feeding with all animal groups. These results might be attributed to more water intake by animals after feeding. Also, no significant differences were found among different animal groups at zero time, but significant (P<0.05) differences were found at 3 and 6 hrs after feeding, showing somewhat higher values with increasing DDGS levels and lower values with progress time after feeding.

Ammonia-N concentrations significantly (P<0.05) increased by adding DDGS in tested rations and progress time after feeding (Table 6). Faichney and White (1977) found that diets containing higher level of protein resulted in higher level NH_3-N concentration in rumen.

Increasing DDGS levels from 11% to 27% in CFM of tested rations had no significant effect on NH_3-N concentration at the different times. So, the narrower range obtained in this study, during different times of taking samples, might be due to more close CP percentages in rations.

Protein-N and NPN concentrations reflected to the total nitrogen concentration, showing higher values with increasing DDGS level in CFM of tested rations and decreasing values with progress time. Differences in NPN concentrations were recorded between low and high levels of DDGS during 3 and 6 hrs. after feeding. Recorded concentration of NPN at 3 hrs after feeding were 37.93, 23.52, 26.14, 30.10 and 33.36 mg/100 ml for animal groups fed rations A, B, C, D and E, respectively. Corresponding values at 6 hrs. were 31.59, 21.65, 22.62, 25.70 and 25.99 mg/100 ml with the respective rations. The high protein-N concentration with animals fed tested ration (containing DDGS) could be explained by somewhat higher percentages CP for these rations than that of control ration. Also, higher concentration of these items might be due to the increased uptake of ammonia by the rumen microflora and according to the higher rate of microbial protein synthesis.

From these results, it could be noticed that the animals fed experimental rations containing DDGS (rations B, C, D and E) showed higher concentrations of ruminal metabolites, i.e. pH value, total VFA's and ammonia-N. In addition, such fluctuation in pH values, NH_3-N and total VFA's concentrations could be attributed to different factors such as ration composition, feeding type and its level, roughage to concentrate ratio and time sampling.

Results were similar with the reported by Etman *et al.* (1986), Mohi El-Din *et al.* (2008), El-Nahas (2010) and Etman *et al.* (2010).

Effect of feeding DDGS on blood parameters:

Data obtained in Table (7) showed some blood parameters. It could be noticed that, results tended to be higher total protein, albumin and globulin for animals fed experimental rations containing DDGS with no significant differences among those parameters. Albumin/Globulin (A/G) ratio as a reflection of both of them indicated the highest ratio with animals fed ration E (containing 27% DDGS). Differences in serum total protein, albumin and globulin concentrations were not significant. Higher concentration of serum total protein and protein fraction may be attributed to improve of nitrogen absorption (Kornegay *et al.,* 1997) and increase CP digestibility (Yousef and Zaki, 2001). Data were agreement with Kumar *et al.* (1980) who reported that there was a positive correlation between dietary protein and serum protein concentration. Also, it could be shown that, all values of A/G ratio were higher than 1.0, which indicated that animals did not suffer from any health problems that might affect on their performance (El-Sayed *et al.,* 2002).

On the contrary, blood creatinin and urea-N concentrations appeared to have lower concentrations with animals fed tested rations containing DDGS than those fed control ration. With respect to enzyme activities, it could be noticed that the AST(GOT) and ALT (GPT) concentrations as a liver function indicators tended to increase with increasing DDGS level in rations, showing significant ($P<0.05$) differences between animals fed control ration and those fed experimental rations. Moreover, Boots *et al.,* (1969) reported that GOT and GPT values depends on several factors such as: feeding practices, genetic control, response to stress, age, liver function and body weight. In general, most of parameters which were studied were not affected by DDGS inclusion in the ration. Results obtained were similar with those reported by Moawd *et al.* (2008) Mohi El-Din *et al.* (2008), Lopez *et al.* (2010) and Etman *et al.* (2010).

Table (7): Blood parameters of animals fed different experimental rations.

Items	Experimental rations					Significant levels
	A	B	C	D	E	
Serum protein (gm/dl)						
Total protein	6.52	6.64	6.81	6.88	6.96	NS
Albumin (A)	3.84	3.80	3.97	3.98	4.08	NS
Globulin (G)	2.68	2..84	2.84	2.90	2.88	
A/G ratio	1.43	1.34	1.40	1.37	1.42	
Liver function (u/ml):						
GOT (AST)	34.95^{b}	38.42^{ab}	40.11^{a}	42.18^{a}	42.86^{a}	(P<0.05)
GPT (ALT)	26.64^{b}	29.15^{ab}	32.16^{a}	35.82^{a}	36.04^{a}	(P<0.05)
Kidney functions:						
Creatinin (mg/dl)	1.42	1.30	1.25	1.24	1.24	NS
Urea-N (mg/100ml)	14.82	14.75	14.64	13.86	13.27	NS

A and b: Means in the same raw with different superscripts are significant (P<0.05) differed.
NS: Not significant

Conclusion

The results obtained in this study showed that the dried distiller grains with soluble (DDGS) could be successfully used as a source of protein in place of soybean meal and a part of glutofeed in concentrate feed mixture for fattening buffalo calves.

Dried distiller grains with soluble (DDGS) could be included at a rate of 27% to cover about 50% of protein for concentrate feed mixture. The last mentioned percentage of DDGS tended to have higher values in digestibility coefficient of all nutrients and nutritive values. Moreover, significantly (P<0.05) increase in daily gain and improve in feed utilization efficiency were achievement. In addition, using 27% DDGS as an ingredient in formulation ration of fattening buffalo calves appeared to lower feed cost/Kg gain, giving the most economical efficiency.

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الاستفادة من مصادر غذائية جديدة في تغذية المجترات:
2- تأثير استخدام النواتج العرضية لتقطيرالحبوب (DDGS) كمصدر للبروتين في علائق تسمين العجول الجاموسي

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كان هدف هذا البحث هو إستخدام النواتج العرضية لتقطير الحبوب (DDGS) كمصدر جزئي للبروتين في علائق تسمين العجول الجاموسي.

إستخدم عدد 50 عجل جاموسي بمتوسط وزن 320.16كجم وقسمت إلى خمسة مجموعات متماثلة في الوزن والعمر (10 حيوانات في كل مجموعة) وغذيت الحيوانات على علف مركز يحتوى على النواتج العرضية لتقطير الحبوب (DDGS) بنسب صفر، 11، 16، 21، 27% ليغطي صفر، 20، 30، 40، 50% من بروتين العلف ا لمركز في المجموعات الخمسة على التوالي، بجانب ذلك غذيت جميع الحيوانات على دريس برسيم وتبن قمح وكانت نسبة المواد المركزة إلى المواد الخشنة 70: 20: 10 للعلف المركز ودريس البرسيم وتبن القمح، على التوالي.

إستمرت تجربة التغذية 184 يوماً وكان يتم وزن الحيوانات كل أسبوعين وفي منتصف تجربة التغذية تم إجراء خمسة تجارب هضم لتقدير القيمة الغذائية والهضمية للعلائق التجريبية المستخدمة كما تم تقدير بعض قياسات الكرش والدم.

وكانت أهم النتائج المتحصل عليها كما يلي:

1 - زادت معاملات هضم كل من المادة الجافة والمادة العضوية والبروتين والألياف زيادة معنوية عند مستوى 5% للعلائق المحتوية على النواتج العرضية لتقطير الحبوب (DDGS) كما زادت في المقابل القيمة الغذائية معبراً عنها بمجموع المركبات الكلية المهضومة والبروتين المهضوم.

2 - أظهرت العليقة التي تحتوى على أعلى نسبة من النواتج العرضية لتقطير الحبوب(العليقة E) أعلى قيمة غذائية مسجلة 77.03% مركبات كلية مهضومة، 12.49% بروتين مهضوم، 3.40 ميجا كالورى/كجم مادة جافة، بينما أظهرت عليقة الكنترول (العليقة A) التي لا تحتوى على مادة الـ(DDGS) أقل قيمة غذائية، وفي هذا السياق فإن كل العلائق التي إحتوت على النواتج العرضية لتقطير الحبوب بالنسب المختلفة (عليقة B, C, D, E) كانت قيمتها الغذائية أعلى من عليقة المقارنة.

3 - كانت أعلى زيادة يومية في وزن الجسم تساوى 1.170كجم للمجموعة التي تغذت على عليقة E (المحتوية على 27% DDGS) وكانت هذه الزيادة تمثل 31.46% تحسناً في وزن الجسم. وقد أظهرت المجموعات التي تغذت على العلائق التجريبية (علائف B, C, D, E) أفضل كفاءة غذائية وكانت قيم هذه الكفاءة تساوى 11.147، 8.586، 1.392 كجم DM، TDN، DCP لكل كيلو جرام نمو على التوالي للمجموعة الخامسة.

4 - أظهرت المجموعة الخامسة التي تغذت على أعلى نسبة من النواتج العرضية لتقطير الحبوب (27% DDGS) أقل تكلفة غذائية لإنتاج واحد كيلو جرام نمو (17.137 جنيهاً) مع أفضل كفاءة إقتصادية (1.233 جنيهاً).

5 - كانت قياسات كل من سائل الكرش والدم داخل النطاق الطبيعي ولم يؤثر استخدام النواتج العرضية لتقطير الحبوب بالنسب المختلفة تأثيراً عكسياً على بعض قياسات الكرش أو الدم بل أدى إلى تحسن في أداء الحيوانات.

وعموماً فإنه يمكن القول أنه يمكن إستخدام النواتج العرضية لتقطير الحبوب كمصدر بروتيني في الأعلاف المركزة المستخدمة في تسمين العجول الجاموسي. وقد وجد أن إستخدام نسبة 27% من النواتج العرضية لتقطير الحبوب لتغطى 50% من بروتين العلف المركز بدلاً من بروتين كسب الصويا وجزء من بروتني الجلوتافيد أدى ذلك إلى تحسن وإرتفاع معاملات هضم المركبات الغذائية وزيادة القيمة الغذائية الأمر الذي أدى إلى إرتفاع وزيادة معدل النمو اليومي مع إنخفاض في تكاليف التغذية وتحسن الكفاءة الإقتصادية دون أى أثر عكسي لهذا المنتج على بعض قياسات الكرش أو الدم.

قام بتحكيم البحث

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