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EFFECT OF USING NATURAL NON-TRADITIONAL GROWTH PROMOTOR: 1- IN-VITRO EVALUATION OF FENUGREEK AS A NATURAL NON-TRADITIONAL GROWTH PROMOTOR AND *IN VIVO* COMPARISON WITH MONENSIN IN BEEF CATTLE RATIONS

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SUMMARY

This study was conducted in two stages: First stage was to in-vitro determine the appropriate level of fenugreek addition to the ration. Second stage, was to in-vivo evaluate the digestibility coefficient and nutritive value of the tested ration as affected by the addition of fenugreek and supplementation of monensin using nine mature Baladi oxen. Samples of fenugreek, concentrate mixture, wheat straw or the complete ration were individually incubated with rumen liquor in triplicates to determine DM, OM, CP, NDF, ADF, Cellulose, Hemi cellulose and ADL degradability, also, to determine basic pattern of fermentation parameters pH, NH_3-N, TVFA, s, VFA, s fractions. Five proportions of fenugreek (1,2,3,4 and 5%) were mixed with the concentrate mixture, wheat straw and the complete ration. Samples of each were incubated with rumen liquor in triplicate to determine the degradability of DM and OM in order to find out the appropriate proportion of fenugreek.

Results of in-vitro study for dry matter and organic matter disappearance of fenugreek and concentrate mixture were higher ($P<0.05$) than those of complete ration and wheat straw. Meantime, the values for complete rations were ($P<0.05$) higher than those of wheat straw. Results of dry matter and organic matter disappearance of concentrate mixture, wheat straw and complete ration supplemented with 1%, 2%, 3%, 4% and 5% fenugreek showed non significant differences among treatments. However 3% level of fenugreek addition to all treatment was the suitable one.

Differences in DM, OM, CP and CF, and NFE in-vivo digestibility for all treatments were not significant except for EE digestibility of control ration which was higher ($P<0.05$) than other treatments. No differences were found in DCP and TDN among tested groups as well as rumen NH_3-N, pH and TVFA, s. However, added both fenugreek and monansin decreased acetic acid and increased propionic acid.

In conclusion, this results may lead us to incorporating fenugreek as natural feed additive at the level of 3% into the complete ration of fattening animal to improve digestibility coefficient and nutritive value compared with Monensin as the synthetic feed additive

Keywords: in-vitro, degradability, digestibility, fenugreek, monensin

INTRODUCTION

Monensin is a biologically active compound produced by a strain of streptomycin cinnamnesis (Haney and Hoehen, 1967) and belonging to the general class of compounds termed polyethers. Shumard and Callender, (1967) indicated that Monensin is effective in preventing coccidiosis in poultry, while, (Fitzgerald and Mansfield 1973) found that it is effective against coccidiosis in ruminants and has moderate in vitro activity against gram-positive organism. Van Nevel and Demeyer, (1977) indicated that fermentation of acetic and butyric acids is less efficient while fermentation of propionic acid is more efficient and theoretically reduces the large loss of methane associated with the production of acetic and butyric acid (Hungate, 1966). Blaxter (1962) reported that to the efficiency of utilization of propionic acid in the ruminant's tissue might be higher than that of the acetic acid. Nitrogen retention was found to be increased in ruminants by propionic more than either acetic or butyric acid (Eskeland *et. al.* 1974). Raun, *et al.* (1976) reported that monensin was the first ionophore seemed to have a beneficial influence on ruminant nutrition. Decreasing ammonia production in the rumen is the most important action of monensin in rumen (Chalupa, 1980). Van Nevel and Demeyer, (1977) found an inhibition of proteolysis as a result of monensin addition in vitro. El-Waziry and Kamal (2001) found a reduction in ruminal protein due to addition of monensin to sheep fed on berseem.

Fenugreek is a leguminous plant cultivated in Egypt as well as many other countries in the Mediterranean. Seeds of fenugreek were found to contain an alcoholic compound acts as oxytocin hormone and also have a hypocholesterolemic and anti diabetic action (Petite *et. al.* 1995 and John and Sons 1996). Fenugreek seeds also found to be rich in protein, fat, minerals (Ca, P, Fe, Zn and Mg) (Sharma, 1986 and Gupta, et. al. 1996). A significant improves in economic efficiency as well as DM, OM, CF, NFE. CP and EE digestibility of lactating buffalo fed ration-contained fenugreek was reported by Khattab *et al.* (2001).

The objective of the present study is to in-vitro evaluate the appropriate level of fenugreek added to ruminant ration as feed additive as well as the digestion coefficient and nutritive value determined in vivo for the nutrients in the ration as affected with the addition of fenugreek or monensin.

MATERIALS AND METHODS

Fenugreek (Trigonilla), concentrate feed mixture, wheat straw and the complete ration were chemically analyzed for dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE) and ash according to (A.O.A.C., 1990) (Tables 1, 2 and 3).

The study was conducted in two stages:

First stage: Samples triplicates of fenugreek, concentrate mixture, wheat straw and the complete ration were individually incubated for 48 hours with rumen liquor collected by a rubber of stomach tube after 4hr feeding from mature rams fed berseem hay only for determining dry matter and organic matter disappearent according to Marten and Barnes (1979). Five proportions of fenugreek (1, 2, 3, 4 and 5%) were mixed with the concentrate mixture, wheat straw and the complete ration (Tables 3, 4 and 5). Samples of each were incubated

with rumen liquor in triplicates for 48 hours to determine the solubility of dry matter and organic matter in order to detect the appropriate proportion of fenugreek to be recommended in the rations of beef animal. Other three tubes of each sample (about 0.5gm) were incubated to measurement protein disappearent according to Kjeldahl method (A.O.A.C., 1990). Also, six tubes (to mixed content of two tubes after incubation) of each sample (about 0.5gm of each tube) were taken to determine neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) disappearant according to Goering and Van Soest (1970). Hemi-cellulose and cellulose were calculated as the difference between NDF and ADF, ADL orderly.

After 48hr incubation three tube of each sample were filtered through four folds of gauze. Each sample was divided into three portions, the first one was used immediately for the estimation of rumen pH and NH_3-N concentration, where as the second portion was preserved by adding 1ml (N/10) HCL and 2 ml orthophosphoric acid to each 2 ml of fluid for determining total volatile fatty acids (TVFA's) and the third portion was kept frozen at (-20 C°) till determine VFA's fractions.

Second stage: According to the results obtained from the In-vitro trials, In-Vivo trials were conducted on three complete rations, formulated from mixture of concentrates (65%), wheat straw (30%) and molasses (5%), Table (3). The first one had neither monensin nor fenugreek and served to be the control while the second, 3% fenugreek on basis DM was added to 2nd concentrate mixture and the third represented rations monensin fed ration (125 mg/h/d), respectively. Monensin was added to 3rd tested rations according to recommendations of previous researches by (Potter *et al.*, 1976, Raun, *et al.*, 1976, Boling *et. al*, 1977 and El-Wazery and Kamal, 2001). Nine mature Baladi oxen weighing 375 Kg were randomly divided into three similar groups, 3 animals each and randomly allotted to rations mentioned above. The preliminary period (as adaptation period) lasted for 30 days followed by a ten days collection period. The rations were offered individuals to be fed ad libitum as a percentage of its LBW of about 4%. The residuals (if any) from the previous day were collected to determine the actual amounts of food consumed. During digestion trials bulls were fed twice a day at 6^{30} and 18^{30} hrs. Fecal samples were collected from the rectum two times daily at 6^{00} and 18^{00} hrs to determine the digestibility of the nutrients by acid insoluble ash (AIA) method according to Van Keulen and Young (1977). Representative samples of fed rations and feces were collected for proximate analysis according to A.O.A.C., (1990). The samples of rumen fluid were collected by using stomach tube before and after 4 and 8 hr of feeding. Ruminal pH was immediately measures by using the HANNA pH-meter (model HI 8424). Total VFA, s concentration was analyzed according to Eadie *et al.* (1967). Molar proportion of VFA, s were analyzed according to Erwin et al. (1961). Ammonia concentration was determined according to Conway method, (1963). Data were statistically analyzed using the general linear model program of (SAS, 1996). The following model was applied in the first stage, $Y_{ij}=\mu+L_i+e_{ij}$, where (y_{ij} = an observation, μ = an effect common to all tubes, L_i = effect of levels of fenugreek, and e_{ij} = experimental error). Also, the data in 2_{nd} stage for feed intake, digestibility were subjected to statistical analysis by a simple one-way classification analysis, the following model was applied, $Y_{ij}=\mu+T_i+e_{ij}$, where

(y_{ij} = an observation, μ = mean of treatments, T_i = effect of treatments, and e_{ij} = experimental error), however, rumen fluid parameters were analyzed as two-way classification analysis, the following model was applied, $Y_{ij}=\mu+T_i+X_j+e_{ijk}$, where ($y_{ij}$ = an observation, μ = mean of treatments, T_i = effect of treatments, X = effect of sampling time and e_{ijk} = experimental error,. Significant differences among treatment means were detected using Duncan's multiple range of test (Duncan 1955).

RESULTS AND DISCUSSION

Chemical composition of ration:

Chemical composition of feed ingredients; formula of concentrate feed mixture; complete rations with fenugreek; wheat straw with fenugreek, concentrate mixture with fenugreek and the experimental rations are given in Tables (1, 2 and 3). Chemical composition in (Table 2) showed that as the level of fenugreek increased CP and EE increased. On the contrary, CF and cellulose content decreased as a result of increasing level of fenugreek in the ration. These observations could be attributed to the fact that fenugreek as a feed ingredient has high level of CP (24.59%), EE (5.8%) and low level of CF compared with other feed ingredients except soybean meal and linseed meal used in formulation experimental ration. The same trends were observed when fenugreek was mixed with the experimental rations (Table 3). These results are in a harmony with the results obtained by Sharma (1986) and Gupta *et al.*, (1996).

Dry matter, organic matter and other nutrients disappearance of tested materials:

As shown in Table (4), it is clearly to notice that dry matter and organic matter disappearance of fenugreek and concentrate mixture are higher ($P<0.05$) than that of complete ration and wheat straw, probably due to its high content of CP, EE, NFE and low content of ash. Meantime for complete ration was higher ($P<0.05$) than that for wheat straw. These differences may be attributed to the fact that wheat straw is by nature poorly digestible compared with concentrate feeds due to its high content of lignified crude fiber (Mehrez *et al.*, 2001). Present results showed that concentrate mixture was higher ($P<0.05$) in CPD compared with other ingredients. On the other hand no significant differences were found in CPD between fenugreek and complete ration, but both were higher ($P<0.05$) than wheat straw. The low disappearance of wheat straw CP compared with other tested materials may be a result of its low content of CP and its low digestibility due to ligno-cellulose (McDonald et al., 1995). As illustrated in Table (4), cell wall constituents of wheat straw showed lower ($P<0.05$) NDFD, ADFD and ADLD compared with the other tested materials. While no significant differences were found among all tested materials in cellulose disappearance. On the contrary, wheat straw was higher ($P<0.05$) in hemi-cellulose disappearance compared with the other tested materials. The above mentioned results may be due to the low digestibility of crude fiber in wheat straw in general while cellulose and hemi-cellulose are in particular the best parts of cell wall constituents to be easily digested by rumen liquor microbes (Omar, 1999). Results of nutrients disappearance of concentrate mixture, wheat straw and complete ration with 1%, 2%, 3%, 4% and 5% of fenugreek are given in Table (5). The results show that, fenugreek at 3% level of incorporation with concentrate mixture showed better nutrients disappearance ($P<0.05$) compared with the other tested

Table (1): Chemical analysis of the feed ingredients on fresh matter basis.

Items	DM	OM	CP	CF	EE	NFE	Ash	NDF	ADF	Cell[11]	Hemi Cell	ADL
SBM[1]	93.2	93.7	47.2	5.3	0.5	40.7	6.4	38.5	29.0	20.7	9.5	8.3
LCM[2]	91.5	88.5	33.5	9.0	7.4	38.6	11.5	39.0	29.9	25.2	9.1	4.6
YC[3]	90.3	89.0	10.0	5.1	5.3	68.6	11.1	36.1	25.4	22.9	10.7	2.5
Fenu[4]	92.4	96.6	26.6	1.8	6.3	61.9	3.4	37.0	24.5	20.4	12.5	4.1
WB[5]	90.5	94.1	13.1	12.0	3.0	66.0	5.9	49.3	34.9	30.2	14.4	4.7
CS[6]	98.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0
LS[7]	98.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0
Min[8].	98.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0
Molas[9]	69.3	83.8	4.4	0.0	0.1	79.3	16.2	0.0	0.0	0.0	0.0	0.0
WS[10]	93.1	89.1	1.	39.6	0.6	47.0	10.9	76.6	61.1	48.6	15.5	12.5
CFM1*	91.3	87.0	19.5	6.9	4.2	56.4	13.0	38.1	27.5	23.5	10.6	4.0
CFM2**	91.3	87.1	20.0	6.6	4.3	56.3	12.9	37.8	27.2	23.2	10.5	4.0
C.R****	90.7	87.5	13.5	16.4	2.9	54.7	12.5	47.8	36.2	29.8	11.6	6.4

1- SBM: - Soybean meal.
2- LCM: - Linseed meal.
3- YC: - Yellow corn.
4- Fenu.:- Fenugreek
5- WB: - Wheat bran.
6- CS: - Common salts.
7- LS: - Lime stone.
8- Min:- Minerals.
9- Molas:- Molasses.
10- WS: -Wheat straw.
11- Cell:- Cellulose

- CFM-1= Concentrate feed mixture 1: consists of 15% soybean M., 16% Linseed cake, 45% yellow corn, 20% wheat bran, 1% Common salt, 2% lime stone, 1% Vit & Min. Mix.**

****- CFM-2 = Concentrate feed mixture2: consists of 15% soybean M., 16% Linseed cake, 45% yellow corn, 17% wheat bran, 3% fenugreek, 1% Common salt, 2% lime stone, 1% Vit. & Min. Mix***.**

*****- Each Kg of Vit. And Min. mix contains 97% NaCl, 0.35% Zn, 0.2% Mn, 0.2 Fe, 0.15% Mg, 0.03% Cu, 0.007% I, 0.0005% Co and 0.002% Se, 7511 IU/g Vit. A and 8800 IU/g Vit. D3**

******- Complete experimental ration (65% conc.+ 30% straw +5% molasses on DM basis).**

Table (2): Chemical composition of concentrate feed mixture, wheat straw and complete experimental ration with different levels of fenugreek.

Items	DM	OM	CP	CF	EE	NFE	Ash	NDF	ADF	Cell*	Hemi-Cell	ADL
Levels of fenugreek with CFM-1.												
1	91.3	87.1	19.5	7.0	4.2	56.5	12.9	38.2	27.6	23.6	10.6	4.1
2	91.3	87.2	19.4	7.0	4.2	56.6	12.8	38.4	27.7	23.6	10.7	4.1
3	91.3	87.3	19.3	7.1	4.2	56.7	12.8	38.5	27.8	23.7	10.7	4.1
4	91.2	87.3	19.3	7.1	4.2	56.8	12.7	38.6	27.8	23.8	10.8	4.1
5	91.2	87.4	19.2	7.2	4.2	56.9	12.6	38.7	27.	23.8	10.8	4.1
Levels of fenugreek with wheat straw												
1	93.1	89.1	1.9	39.4	0.7	47.2	10.9	76.3	60.8	48.4	15.5	12.4
2	93.1	89.2	2.0	39.1	0.7	47.4	10.8	76.0	60.5	48.2	15.5	12.3
3	93.0	89.2	2.1	38.8	0.7	47.6	10.8	75.8	60.3	48.2	15.5	12.3
4	93.0	89.3	2.3	38.5	0.7	47.8	10.7	75.5	60.0	47.8	15.5	12.2
5	93.0	89.3	2.4	38.3	0.7	48.0	10.7	75.2	59.7	47.7	15.5	12.1
Levels of fenugreek with complete ration**												
1	90.7	87.6	13.5	16.3	2.9	54.8	12.5	47.8	36.2	29.8	11.6	6.4
2	90.7	87.6	13.4	16.3	2.9	55.0	12.4	47.8	36.2	29.9	11.6	6.3
3	90.7	87.7	13.4	16.2	2.9	55.1	13.3	47.8	36.2	29.9	11.6	6.3
4	90.7	87.7	13.4	16.2	2.9	55.2	12.3	47.8	36.2	29.9	11.7	6.3
5	90.7	87.8	13.4	16.2	2.9	55.3	12.2	47.8	36.1	29.9	11.7	6.3

* Cell.:- cellulose.
**Complete experimental ration (65% conc.+ 30% straw +5% molasses on DM basis).

Table (3): Formula of concentrate feed mixture, experimental rations and its chemical composition on dry matter basis.

Items	Control	Fenugreek	Monensen
% of ingredients.			
CFM-1	65	--	65
CFM-2	--	65	--
Molasses	5	5	5
Rice straw	30	30	30
Chemical composition on DM basis %			
DM	90.72	90.75	90.72
OM	87.48	87.54	87.48
CP	13.45	13.72	13.45
CF	13.37	13.17	13.37
EE	2.94	3.01	2.94
NFE	54.72	54.64	54.72
Ash	12.52	12.46	12.52
Cell wall constituents %			
NDF	47.76	47.52	47.76
ADF	36.21	36.01	36.21
ADL	6.37	6.36	6.37
Cellulose	29.84	29.65	29.84
H-Cellulose	11.55	11.51	11.55

Table (4): Nutrients disappearance and fermentation of tested materials.

Items	Feeds				
	Fenugreek	Concentrate Mixture	Wheat Straw	Complete Ration	±SE
Disappearance. %					
DMD	59.34^{a}	60.42^{a}	39.31^{c}	51.06^{b}	1.800
OMD	71.27^{a}	67.31^{a}	43.86^{c}	57.16^{b}	1.900
CPD	49.90^{b}	52.40^{a}	41.30^{c}	47.80^{b}	1.300
NDFD	41.10^{b}	42.70^{a}	38.70^{b}	41.70^{b}	0.640
ADFD	31.80^{ab}	32.50^{a}	28.00^{b}	32.30^{ab}	0.780
Cellulose –Dis.	4.06^{b}	5.20^{a}	3.50^{b}	3.90^{b}	0.230
H. Cellulose –Dis.	37.30	36.40	134.30	37.80	0.780
ADL	59.20^{c}	68.90^{b}	80.50^{a}	71.10^{b}	2.400
Fermentation Parameters					
pH	6.24^{b}	7.04^{a}	6.45^{b}	6.43^{b}	0.009
NH_3-N (mg%)	5.0^{c}	8.2^{a}	4.0^{d}	7.0^{b}	0.450
TVFA, s (meq. /100ml)	6.0^{c}	8.3a	7.6^{b}	8.6^{a}	0.310
Acetic acid %	48.0^{c}	58.0^{b}	63.5a	58.3^{b}	1.760
Propionic acids %	32.4^{a}	24.4^{b}	20.0^{bc}	22.5^{b}	1.460
Butyric acid %	14.3^{a}	12.5^{b}	11.0^{c}	13.1^{b}	0.370
Iso-butyric acid %	1.9^{a}	1.5^{b}	1.8^{a}	1.9^{a}	0.006
Valeric acid %	1.6	1.6	1.8	1.6	0.005
Iso-Valeric acid %	1.8^{b}	2.0^{b}	1.9^{b}	2.6^{a}	0.110

Means of 3 samples in each treatment.
a, b and c: Means in the same row within each parameter having different superscripts differ Significantly (P<0.05).
CPD: - Crud protein disappearance, NDFD: - neutral detergent fiber disappearance, ADFD: -Acid detergent fiber disappearance Cellulose. -Dis.: Cellulose disappearance, H.Cellulose. -Dis.: Hemi cellulose disappearance ADL: Acid detergent fiber disappearance

Table (5): Nutrients disappearance of tested materials as affected with different levels of fenugreek.

Items	Levels of fenugreek					
	1%	2%	3%	4%	5%	±SE
Concentrate mixture						
DMD %	58.91	60.31	62.42	62.42	60.00	1.8
OMD %	56.8	67.3	70.0	67.0	60.0	2.0
CPD %	42.8^{bc}	48.1^{a}	49.01^{a}	46.6^{ab}	44.7^{bc}	0.71
NDFD %	35.5^{ab}	37.0^{ab}	38.9^{a}	35.9^{ab}	34.9^{b}	0.55
ADFD %	25.2^{c}	26.6^{bc}	30.2^{a}	27.4^{b}	25.5^{c}	0.53
Cellulose Dis. %	28.1^{c}	29.4^{bc}	33.5^{a}	30.5^{b}	28.4^{bc}	0.58
H.Cellulose Dis. %	62.2	63.9	61.4	57.7	58.5	1.60
ADLD[6] %	4.7^{c}	6.6^{ab}	6.9^{a}	5.5^{bc}	5.8^{c}	0.28
Wheat Straw						
DMD %	42.9	43.5	43.0	41.0	39.0	2.6
OMD %	48.1	48.8	48.1	46.8	43.5	2.7
CPD %	37.0	35.7	36.7	36.0	34.6	0.40
NDFD %	32.3	32.5	32.2	31.2	30.3	0.41
ADFD %	21.2bc	22.1ab	23.0a	20.7cd	19.5d	0.36
Cellulose Dis. %	25.8ab	26.8ab	27.7a	24.9bc	23.5c	0.45
H.Cellulose Dis. %	75.7	73.2	67.9	72.2	71.6	0.45
ADLD %	3.3	3.6	4.5	3.5	3.8	0.18
Complete ration						
DMD %	49.5	54.6	60.9	54.2	52.8	2.30
OMD %	55.7	61.4	68.4	60.1	59.6	2.50
CPD %	41.9^{c}	46.1^{ab}	47.2^{a}	44.0^{bc}	42.4^{bc}	0.70
NDFD %	32.5	35.7	39.0	32.6	33.7	0.60
ADFD %	23.6	24.7	26.9	24.3	23.0	0.60
Cellulose Dis. %	27.7	29.9	31.6	28.4	27.0	0.70
H.Cellulose Dis. %	60.0^{b}	69.6^{a}	63.8^{ab}	58.3^{b}	66.3^{ab}	1.50
ADLD %	3.6	4.2	3.9	3.9	3.6	0.16

Means of 3 samples in each treatment.
a, b and c: Mean in the same row within each parameter having different superscripts differ significantly ($P<0.05$)

levels. For wheat straw, it is clearly to realize that an increase in DMD, OMD, CPD, NDFD, ADFD and ADLD as the level of fenugreek incorporation increased up to 3%, was accompanied with a decline in the disappearance of these nutrients above this level. (Abo El-Nor 1999 and Allam *et al.*, 1999) found that, added fenugreek to tested rations improved significantly digestibility coefficients of DM, CP and CF. The improvement of nutrient disappearants with added fenugreek could be illustrated on the basis that these seeds contain saponins which stimulate anaerobic fermentation of organic matter that improve efficiency of utilization of nutrients. In addition, rations supplemented with saponins increased bacterial number in the rumen. (Valdez *et al.*, 1986). Also, Goetsch and Owen, (1985) found that ruminal nitrogen digestion tended to be increased ($P<0.05$) when rations cows was supplemented with saponins (44ppm). On the other hand, an opposite result was obtained with hemi-cellulose disappearance. The same trends were almost observed with nutrients disappearance with complete ration as affected with adding different levels of fenugreek.

The above-mentioned results may lead us to incorporating fenugreek as natural feed additive at the level of 3% into the complete ration of fattening animal in order to evaluate the digestibility coefficient and nutritive value compared with Monensin as the synthetic feed additive

Nutrients fermentation of tested materials:

Results of fermentation of the tested materials nutrients are shown in Table (4). The values of pH and ammonia concentration of concentrate mixture were higher ($P<0.05$) than those of fenugreek, complete ration and wheat straw. The lower values of ammonia nitrogen concentration for fenugreek treatment might be due to gum (which is found in fenugreek seeds) that leads to decrease protein solubility in the rumen liquor (Udayasekhra and Sharma 1987) and/or to enhancing the efficiency of utilization of dietary nitrogen by rumen microorganisms (Nazar, 1994). So, fenugreek seeds could be considered as microbial protein stimulants that increase dietary protein utilization (Nazar, 1994). Concentrate mixture and complete ration produced ($P<0.05$) higher TVFA's compared with fenugreek and wheat straw. However wheat straw produced ($P<0.05$) higher acetic acid compared with the other tested materials. This significant increase in acetic acid production of wheat straw could be attributed to the high content of cellulose and hemi-cellulose proportions of cell wall constituents, which are the main source of acetic acid production. As shown in Table (4), fenugreek produced higher ($P<0.05$) proportion of propionic and butyric acid compared with the other tested materials. Since propionic and butyric acids are the desirable results of fermenting feeds in the rumen for beef animal. These observations could highlight that fenugreek is a desirable additive in rations of beef animal. Those results are in good agreement with Valdes *et al.*, 1986, Abo El-Nor 1999 and Allam *et al*, 1999. Goodal (1980), who found that, saponin (which are found in fenugreek seeds) increased propionic acid and decreased acetic acid ($P<0.005$).

Results of nutrients fermentation of concentrate mixture, complete ration as well as wheat straw as affected with incorporation of different levels of fenugreek are presented in Table 6. Incorporation of fenugreek at 3%and 4% levels with concentrate mixture were significantly ($P<0.05$) better in NH_3-N concentration compared with other levels. TVFA's concentration was

(P<0.05) higher with 3% level than other tested levels. Also propionic and butyric acids concentration were better with 3% level compared with the other tested levels .On the other hand acetic acid concentration decreased (P<0.05) of fenugreek increased than level 3%. Concerning complete ration, it was realized that no significant differences were observed in PH, NH_3-N and TVFA's among five tested levels. Acetic acid concentration decreased (P<0.05) when the level of incorporation increased above 3% while propionic had opposite results. No significant differences were found among five tested levels in concentration of butyric acid, as shown in Table (7).

The lowest pH (P<0.05) was recorded at 1% level of incorporating fenugreek with wheat straw. No significant differences were found among tested levels in NH_3-N and TVFA's concentration. Lower concentration of acetic acid was associated with the increase in the level of fenugreek, while the opposite trend was observed with concentration of propionic acid. Butyric acid concentration significantly (P<0.05) increased up to 3 % level then decreased. Results of nutrients fermentation of concentrate mixture, wheat straw and complete ration as affected with different levels of fenugreek could be parallel with the results of nutrients disappearance of the same materials as mentioned above to confirm incorporation of fenugreek as feed additive in ration of beef animal at level of 3 % in order to achieve a satisfactory level of growth and economic performance as a result of in vitro evaluation of this study.

Feed intake, digestibility coefficient and nutritive value:

Feed intake, digestibility coefficient and nutritive value of formulated rations are presented in Table (7). Added fenugreek significantly increased dray matter intake (DMI), and crud protein intake (CPI) compared with both control and monensin. Although, added fenugreek increased total digestible nutrient intake (TDNI) the differences wan not significantly compared with control, however, difference was differ compared with monensin. Results of DM, OM, CP and CF digestibility for control, control plus fenugreek and control plus Monessen showed no significant differences, however slight improvement in CP digestibility was realized for ration contained fenugreek compared with the other treatments. Those resultes may be due to Fenugreek seeds is rich in protein, fat, minerals (Ca, P, Fe, Zn and Mg) (Sharma, 1986 and Gupta *et al.* 1996). Goetsch and Owens, (1985) found that ruminal nitrogen digestion tended to be increased (P<0.05) when rations of cows was supplemented with saponins (44ppm). In spite of non significant differences were observed in CF digestibility among the three rations, slight improvement was found in rations contained fenugreek and monensen compared with the control ration. EE digestibility of control ration was higher (P<0.05) than those of fenugreek and monensen rations. Concerning NFE digestibility no significant differences were found among the three groups. The improvement in digestion coefficient of ration containing of fenugreek seeds could be illustrated on the basis that these seeds contain saponins which stimulate anaerobic fermentation of organic matter that improve efficiency of utilization of nutrients. In addition, ration supplemented with saponins increased bacterial number in the rumen of lactating cows (Valdez *et al.*, 1986).

Nutritive value of the three tested rations expressed as DCP and TDN are given in Table (7). Statistical analysis showed no significant differences among three rations in DCP and TDN. The

Table (6): Fermentation of different tested material as affected by different levels of Fenugreek.

Items	Levels of fenugreek					
	1%	2%	3%	4%	5%	±SE
Concentrate mixture						
pH	63.3	6.2	6.2	6.2	6.2	0.004
NH_3-N (mg/100ml)	5.5^{c}	6.7^{b}	8.0^{a}	7.7^{a}	6.5^{b}	0.240
TVFA, s (meq/100ml)	9.2^{ab}	9.0^{bc}	9.6^{a}	8.5^{c}	7.6^{d}	0.190
Acetic acid %	63.9^{a}	60.9^{a}	57.4^{b}	58.3^{b}	59.7^{b}	0.800
Propionic acid %	19.7^{c}	21.8^{bc}	24.4^{ab}	26.0^{a}	23.5^{ab}	0.690
Butyric acid %	11.7^{ab}	11.6^{ab}	12.6^{a}	10.8^{b}	12.1^{a}	0.120
Iso-butyric %	1.1^{d}	1.9^{a}	1.5^{bc}	1.4^{cd}	1.8^{c}	0.008
Valeric acid %	1.7	1.9	1.9	1.7	1.7	0.004
Iso-Valeric %	1.9^{c}	1.9^{c}	2.2^{b}	1.8^{c}	2.6^{a}	0.008
Wheat Straw						
pH	4.0^{b}	4.5^{a}	4.9^{a}	5.0^{a}	4.6^{a}	0.110
NH_3-N (mg/100ml)	6.4	6.3	6.2	6.3	6.3	0.003
TVFA, s (meq/100ml)	8.7	9.0	9.2	9.0	9.0	0.008
Acetic acid %	58.3^{a}	55.6^{ab}	54.7^{ab}	55.6^{ab}	51.7^{b}	0.720
Propionic acid %	22.5^{d}	24.7^{c}	27.3^{b}	29.0^{a}	30.6^{a}	0.820
Butyric acid %	13.1^{a}	13.3^{a}	12.5^{a}	11.1^{b}	11.0^{b}	0.270
Iso-butyric %	1.9^{a}	1.8^{ab}	1.8^{ab}	1.3^{b}	1.3^{b}	0.009
Valeric acid %	1.6	1.8	1.7	1.4	1.5	0.006
Iso-Valeric %	2.6^{a}	2.8^{a}	2.0^{b}	1.6^{b}	1.6^{b}	0.150
Complete ration						
pH	6.4	6.4	6.4	6.4	6.3	0.005
NH_3-N (mg/100ml)	5.4	5.6	5.5	5.4	5.5	0.009
TVFA,s (meq/100ml)	9.0	9.2	9.1	8.7	8.1	0.170
Acetic acid %	56.2^{a}	56.4^{a}	51.7^{ab}	48.0^{bc}	53.8^{c}	1.000
Propionic acid %	24.4^{c}	25.2^{c}	29.0^{c}	30.6^{ab}	32.4^{a}	0.900
Butyric acid %	13.6	12.8	13.1	13.3	14.3	0.600
Iso-butyric %	1.7^{a}	1.7^{a}	1.3^{b}	1.3^{b}	1.9^{a}	0.008
Valeric acid %	1.7^{b}	1.9^{a}	1.4^{c}	1.5^{c}	1.6^{b}	0.005
Iso-Valeric %	2.4^{a}	2.0^{b}	1.6^{c}	1.6^{c}	1.8^{b}	0.009

Means of 3 samples in each treatment. a, b and c Mean in the same row within each parameter having different superscripts differ significantly (P<o.o5)

Table (7): Effect of adding Fenugreek and Monensin on feed intake, digestibility coefficients and nutritive values of rations fed to experimental animals.

Items	Dietary treatments			
	Control	Fenugreek	Monensen	±SE
Feed Intake				
DMI (kg/h/d)	13.27^{b}	14.03^{a}	13.00^{b}	0.027
TDNI (kg/h/d)	9.16^{ab}	9.74^{a}	8.88^{b}	0.008
CPI (kg/h/d)	1.805^{b}	1.936^{a}	1.768^{b}	0.004
Nutrient digestibility %				
DM	80.37	80.30	80.63	0.700
OM	84.31	83.74	83.48	1.000
CP	66.33	67.42	63.87	1.601
CF	56.41	60.26	59.55	1.600
EE	80.23^{a}	75.74^{b}	74.52^{b}	0.800
NFE	80.89	80.42	79.86	0.900
Nutritive value %				
TDN	69.00	69.60	68.30	1.700
DCP	9.15	9.50	8.80	0.050

Means of 3 animals in each treatment. a, b and c: Means in the same row within each parameter having different superscripts differ significantly (P<0.05). DMI: Dry matter intake. TDNI: -Total digestible nutrients intake. CPI: - Crud protein intake.

observed reduction in CP digestibility due to addition of monenesen to the ration could be attributed to the capability of ruminants to normally obtain some glucose from amino acids (Reilly and Ford, 1971 and El-Wazery and Kamal, 2001). Adding Monensin to ruminant rations improved feed intake, growth rate and weight gain (Boling *et al.*, 1977 and Byers 1980). Fenugreek addition to beef and dairy animal found to increase growth performance and milk production (Abo El-Nor 1999 and Allam *et al.*, 1999).

Rumen fermentation parameters

Results of ammonia, pH and total volatile fatty acids of the rumen as affected with addition of fenugreek and monenesen to the rations are given in Table (8). No significant differences were found among tested rations in rumen NH_3-N, pH or volatile fatty acid at 0, 4 and 8 hours of sampling. These results are in a harmony with findings obtained by Fulton *et al.*, (1979 a & b) and Burin *et al.*, (1988). El-Waziry and Kamal (2001) found an increase in total volatile fatty acids in the rumen of the sheep fed berseem hay supplemented with monensin.

Volatile fatty acids fractionations

Results in Tabel (8) clearly showed that, no significant effect of added fenugreek and monansin on ruminal pH, concentration of TVFA, s and ammonia nitrogen. This results were a good agreement with Udayaskekhara and Sharama, (1987) when who added fenugreek, and Raun *et al.*, (1976) when who added monansin. In spite of non-significant differences were observed in proportion of acetate at different sampling time, the concentration of acetate was significantly lower with added both fenugreek and monensin compared to control diet. Results obtained revealed that differences among the three tested rations were significant higher in concentration of propionic in the rumen at 4 hours of sampling time with added either fenugreek or monensin, also with overall mean. However, proportion of butyrate was not significantly differing with fed fenugreek and monansin at different time or overall mean. Burin *et al.*, (1988) showed that ration contained monensen induced increase in acetic acid concentration in the rumen compared with group fed ration contained fenugreek and the control. The same trend was also observed for propionic acid. Goodall (1980), who found that saponins (which are found in fenugreek seeds) increased propionic acid and decreased acetic acid ($P<0.05$) in steers. A slight reduction in butyric acid concentration was realized in-group fed ration supplemented with monenesen compared with control and fenugreek fed groups (MacKing *et al*, 1980). Potter *et al*, (1976) found that molar proportion of ruminal acetic acid and butyric acid were decreased by monensen while propionic acid proportion increased. These changes in the proportion of rumenal VFA should decrease the energy losses associated with the rumenal fermentation and should account for some of the observed improvement in daily gain and efficiency of feed utilization. These findings are in partial agreement with the obtained results of this current study. Also, Byers (1980) and El-Waziry and Kamal, (2001) found similar results for acetic, propionic and butyric acids proportions as affected with supplementing ruminant rations with monensin. Concerning the effect of adding fenugreek to the ration on acetic, propionic and butyric acids proportions Singh *et al.*, (1991) and Nazar (1994) found similar results as obtained through this study.

In conclusion, incorporating fenugreek as natural feed additive at the

Table (8): Effect of adding Fenugreek and Monensin on some rumen parameters.

Items	Time	*Diets*			
	Hours	Control	Fenugreek	Monensin	±SE
NH_3-N	0	12.86	12.80	10.96	0.90
(mg/100ml)	4	16.90	16.97	15.90	0.99
	8	15.51	14.98	14.06	0.90
Overall means		15.10	14.9	13.6	0.52
pH	0	6.42	6.40	6.39	0.05
	4	6.03	5.99	5.99	0.02
	8	6.34	6.23	6.22	0.07
Overall means		6.30	6.20	6.20	0.45
TVFA, s	0	9.78	9.99	10.32	0.30
(meq/100ml)	4	12.97	13.67	13.13	0.30
	8	10.51	10.91	10.91	0.20
Overall means		11.10	11.50	11.50	0.36
Acetic	0	39.69	36.69	36.89	1.40
acid (%)	4	48.97	43.96	43.83	1.70
	8	40.25	39.51	41.35	1.50
Overall means		43.00[a]	40.10[b]	40.70[b]	1.64
Propionic	0	13.09	16.06	17.44	2.60
acid (%)	4	16.79[b]	22.75[a]	23.05[a]	3.20
	8	13.74	16.61	18.39	2.70
Overall means		14.50[b]	18.5[a]	19.6[b]	2.44
Butyric	0	3.49	3.20	2.68	0.30
Acid (%)	4	5.64	5.28	5.28	0.50
	8	4.26	3.80	3.10	0.40
Overall means		4.50	4.10	3.70	0.30

Means of 3 animals in each treatment. a, and b: Means in the same row within each parameter having different superscripts differ significantly ($P<0.05$).

level of 3% into the complete ration of fattening animal improved the digestibility coefficient and nutritive value compared with Monensin as the synthetic feed additive.

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تأثير استخدام منشطات نمو طبيعية غير تقليدية: ١- التقييم المعملي للحلبة كمنشط نمو طبيعي غير تقليدى ومقارنته بالمونانسن على حيوانات اللحم

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تم أجراء هذا البحث على خطوتين الأولى: بهدف تحديد المستوى المناسب لاضافة الحلبة الى العلائق والذى يحقق اعلى مستويات هضم ممكنة • والخطوة الثانية بهدف دراسة تاثير المستوىالذى تم تحديدة والذى حقق اعلى هضم ومقارنتة بالمونسين من ناحية تاثيرة على معاملات الهضم والقيم الغذائية.

أظهرت نتائج الدراسة بأن معدل اختفاء المادة الجافة للحلبة والمخلوط المركز للعلف المحضن مع سائل الكرش في أنابيب الاختبار كان معنويا أسرع من العليقة المتكاملة و قش الأرز كما أن المادة الجافة للعليقة المتكاملة كانت اسرع معنويا فى الاختفاء من قش الارز. كان معدل اختفاء المادة الجافة غير معنوي لمستويات ١%، ٢%، ٣%، ٤%، ٥% من الحلبة المضاف ألي العلائق المختبرة ألا أن مستوى ٣% من أضافه الحلبة أعطت أفضل النتائج. و في تجربة هضم بإستخدام ٩ ثيران بالغة ، وجد أنه بمقارنة معاملات هضم العلائق المضاف إليها حلبة ومونانسن وعليقه المقارنة للمادة الجافة والمادة العضوية و البروتين الخام والألياف الخام والدهن والمستخلص الخالي من الأزوت تبين أنه لا توجد فروقا معنوية بين المعاملات الا أنه كان هناك تحسنا فى معامل هضم البروتين والألياف للعليقة المضاف أليها الحلبة بالمقارنة بالعلائق الأخرى وكذلك وجد تحسنا في الألياف الخام في العليقة المضاف أليها والمونانسن. وجد أن معامل هضم الدهن في عليقه المقارنة كان أعلى معنويا من العلائق المضاف أليها الحلبة والمونانسن أما بالنسبة لمعامل هضم المستخلص الخالي من النيتروجين وقيم البروتين المهضوم والمركبات الكلية المهضومة لم توجد فروقا معنوية بين المعاملات. لم توجد فروقا معنوية في تركيز الامونيا و درجة الحموضة والأحماض الدهنية الطيارة الكلية بالكرش إلا أن تركيز حمض الخليك انخفض مع إضافة كلا من الحلبة والمونانسن في حين ازداد تركيز البروبيونات مع إضافة كلا من المادتين المختبرتين معنويا في نفس الوقت لم يكن هناك فروق معنوية في تركز البيوتيرات رغم انخفاض مستواه مع إضافة المونانسين•

نستنتج من نتائج هذة الدراسة امكانية اضافة الحلبة بنسة ٣% كمنشط نمو طبيعى بديلا عن المونسين فى علائق عجول التسمين وذلك لتحسين معاملات الهضم.