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EFFECT OF ADDITION DIFFERENT LEVELS OF DRIED ONION AND GARLIC ON DIGESTIBILITY, CAECOTROPHY AND CAECUM ACTIVITY OF RABBITS

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ABSTRACT

A total number of 42 male New Zealand white (NZW) rabbits at the age of 14 weeks were randomly divided into seven experimental groups (6 male for each) to study the effect of adding dried onion (DO) and garlic (DG) on nutrients digestibility , caecotrophy and caecum activity. Rabbits were fed a basal diet supplemented with different levels of DO and DG as follows: 1) control group (CG), 2) CG+1 % DO, 3) CG+1.5 % DO, 4) CG+1% DG, 5) CG+1.5 % DG, 6) CG +0.5 % DO+0.5% DG, 7) CG +0.75% DO +0.75 % DG, respectively. All diets were formulated to be iso-nitrogenous and iso-caloric. The obtained data showed that dry matter intake did not significantly differ among dietary treatments as well as it was similar for collared rabbits compared with those uncollared. The CP digestibility coefficient was significantly ($p<0.05$) higher for rabbits fed diets included 1.5 % DG, 1.5 % DO, 0.5 % DO+ 0.5% DG and 1 % DG than those fed either control diet or other groups. Rabbits fed 0.5% Do + 0.5% DG diet recorded significantly higher CF digestibility ($P<0.05$) than the other treated groups. The nutritive values expressed as TDN%, DE and ME Kcal/Kg DM of diet supplemented with 0.5% DO +0.5% DG were significantly ($p<0.05$) higher than those fed 1% Do. The DCP% for 1.5% DO, 1% DG, 1.5%DG and 0.5% DO+0.5% DG diets was significantly ($p<0.05$) higher than 1% DO, 0.75% DO+0.75%DG and control groups. The digestibility coefficients of all nutrients as well as nutritive values of tested diets were similar between uncollared and collared groups .Treatment groups showed significant ($p<0.05$) increase in Bacterial total count compared with the control group.

Keywords: rabbits, onion, garlic, digestibility, nutritive value, caecotrophy, caecum activity.

INTRODUCTION

Modern animal production requires the use of safe and effective additives to stimulate feed consumption and destroy harmful microorganisms of the diet, in addition to be used as rumen manipulators to increase animal productivity (Ahmed *et al,* 2009). Several attempts were conducted to use natural materials such as medicinal plants as feed additives could be widely accepted (line-Eric *et al*; 1998 and Aboul-fotouh *et al;* 2000). The World Health Organization (WHO) encourages using medicinal herbs and plants to substitute or minimize the use of chemicals through the global trend to go back to the nature (El-Ashry *et al* 2006). Many investigators reported that garlic and onion are highly inhibitory to E.coli and to other bacteria and fungi, e.g. antibacterial and antifungal (Wager *et al*; 1994 and Kumar and Berwal 1999). Nutritional activities of garlic and onion have been widely studied. The active inhibitory agents of garlic are allicin and/or daily thiosolphinic acid

allicin which is enzymatically released from precursor form when the garlic and onion bulbs are crushed (Saleem and Al-Delaimy 1982). With rabbit (Elelamei 2001; Helal and Mohamed 2001; El-Hindawy *et al* 2003 and Abdel –Azeem and Abdel-Reheem 2006) and crossbred heifers and growing buffalo calves (Gupta *et al* 2005 and Aiad *et al* 2008). Onion and garlic supplementation showed an improvement in animal performance, gross activity of caecum or rumen microflora. However, such effects of these additives could be differ according to many variables e.g. type and level of these additive, animal species, plane of nutrition ,management conditions. Therefore, the present study was designed to evaluate the effects of onion and garlic addition as natural safe feed additives in rabbit diets on digestibility, caecotrophy status and caecum activity.

MATERIALS AND METHODS

The present study was carried out at the Rabbit's Farm, Department of Animal Production, Faculty of Agriculture, Moshtohor, Banha University, Egypt. The experiment was done during the period from May to July 2009.

Experimental diets

The composition and calculated chemical analysis of the experimental diets are presented in Table (1).

Diets were formulated by mixing dried onion (DO), dried garlic (DG) and the mixture of both at levels 1, 1.5%, (0.5% DO + 0.5 %DG) and (0.75 % DO + 0.75 % DG), respectively. Seven experimental diets were formulated to be iso-caloric and iso-nitrogenous. All diets and supplements covered the daily nutrients requirements of growing rabbits according to NRC (1977) and Cheeke (1987). Diets were pelleted at investment unit, Poultry Production Department, Faculty of Agriculture, Mansoura University, Dakahlia Governorate, Egypt.

Digestibility trail and caecotrophy test.

A total number of 84, unsexed, New Zealand White (NZW) weaned rabbits at 5 weeks old, were randomly divided into seven experimental groups (12 rabbits each) for growing trail lasted for 5-14 weeks of age. The data of first part of this study concerning the rabbits performance and blood parameters will be presented later one (Gabr *et al*, 2011). Seven digestion trails and caecotrophy tests were performed. At the end of the growing trail, a total number of 42 male rabbits were selected randomly from the previous herd and fed on the same dietary treatments (6 male for each treatment, 3 with collar to prevent caecotrophy and 3 without collar, to allow caecotrophy) and were allotted to meet the different treatments. The rabbits were housed individually in metabolic cages with a screen allowing facilitating the collecting faeces uncontaminated with urine through the digestibility trail. Quantitative collection of faeces was started 24 hrs after offering the daily feed. Faeces of each male were collected and feed intake was recorded daily in the morning for a collecting period 10 days was preceded by anther 7 days as a preliminary period. The same feeding regimes used during the feeding trial (5-14weeks of age) were also followed through the digestibility trail. Collected

faeces for each male of each treatment were mixed, sprayed with 10%sulphuric acid and toluene for trapping any ammonia released, dried at 70 C for 72 hrs; finally ground and kept for later chemical analysis. The composition of ingredients used to formulate the experimental diets and calculated chemical analysis (Table, 1) was based on the published data obtained from national research council (NRC, 1977) and Cheeke (1987) of rabbits. The determined chemical analysis of tested diets and additives are presented in Table (2). Both diet and faeces were chemically analyzed according to the conventional methods of association of official analytical chemists (A.O.A.C.2000) .Chemical analysis was done at laboratory of Anim. Prod. Dept., fac. of Agric. at Moshtohor, Banha Univ., Egypt.

Caecum activity specimens

At the end of the growing trial (14 weeks), four rabbits of each treatment were slaughtered. Samples of caecum content were taken individually from the slaughtered rabbits from each treatment after being fasted for 16 hrs. The pH values were determined instantly after slaughtering by inserting the pH probe meter eloctroid in caecal appendix contents. Afterwards, the caecal appendix fluid were taken and stored at -20 C^{o} until estimation of caecum microflora (bacteria) total count, *Escherichia coli* count, *Salmonella* and *shigela*. Standard methods using nutrient agar medium was used to estimate the total bacterial counts by pour plate count technique according to British Standard Institution (1991). Bacteria Coliform group were counted on MCconkey's bile medium, according to (Difco Manual, 1984).
Salt aga. *Salmonella* and *Shigella* were counted on S.S. agar medium, according to (Difco Manual, 1984).

Statistical analysis:

The obtained data were statistically analyzed using the General Linear Model (GLM) procedure described in SAS user's Guide (SAS, 2002) according to the following statistical model:

1).Digestibility data were analyzed for the effects of treatments, coprophagy and the interaction between treatments and coprophagy

$Y_{ij}k= \mu + T_i + C_j + (TC)_{ij} + E_{ij}k$

Where:

$Y_{ij}k$=The $_{ij}K^{the}$ observation μ= The overall mean.

T_i= The fixed effect of treatment (T=1, 2……., 7)

C_j= The fixed effect of coprophagy status, (J=1,2)

$(TC)_{ij}$= The fixed effect of interaction between i^{th} treatment and j^{th} coprophagy status.

$E_{ij}k$=Random error associated with $_{ij}k^{th}$ observation and assumed to be independently and normally distributed (with a mean zero and variance $ð^2e$). It includes all the other environmental and genetic factors not specific in model.

2).Caecum activity was analyzed for the effects of treatment only using the following model.

$Y_{ij} = U + T_i + E_{ij}$

Where:

Y_{ij} = The observation on the i^{th} treatment U = Overall mean

T_i = Effect of the i^{th} treatment. E_{ij} = Random error treatment.

Duncan's multiple range test (Duncan, 1955) was also used for the comparison among means of the experimental groups.

RESULTS AND DISCUSSION

Chemical analysis of tested diets, dried onion (DO) and garlic (DG):

The determined and calculated chemical analysis of tested diets (Table 1&2) showed that all tested diets were practically similar, being formulated to be iso-nitrogenous and iso-caloric as designed. In addition, the chemical composition of DO and DG % was similar in DM, OM, CP and Ash contents , while EE in DO was higher than that of DG (0.68 vs 0.25%, respectively), and the reverse trend was true in case of CF (2.88 vs 5.27 % ,respectively). Similar chemical analysis for DG have been recorded by Nwinuke *et al* (2005), Grela and Kelbaniuk (2007) and Otunola *et al* (2010) and for DO (Farral ,1985 and Nwinuka *et al* 2005).

Table (1): Calculated composition of the basal diet.

Ingredients:	**Quantity (%)**
Alfalfa hay	36
Yellew corn	10
Soybean meal(S.B.M)	8.6
Wheat bran	31
Barley grains	9.5
DL-methionine	0.1
Molasses	3.0
CaCo3	1.0
NaCl	0.5
Vitamin and mineral premix	0.3
Total	100
Calculated diet composition:	
Dry matter (D M) %	91.09
Crude protein (%)	16.20
Ether extract (%)	2.79
Nitrogen free extract (NFE)%	49.9
Ash (%)2	8.10
DE (Kcal /Kg diet) 5	2473.41
Crude fiber (%)	14.10
Neutral detergent fiber (NDF %)* 3	38.19
Acid detergent fiber (ADF %)** 3	22.29
Hemicellulose (%)4	15.9
Calcium (%)1	0.956
Phosphorus (%)1	0.527
Lysine (%)1	0.71
Sulfer amino acid (S .A.A%)1	0.60

1. Calculated according to Cheeke (1987) 2. Calculated according to NRC 1977,
3. Calculated according to Pagno Toscan *et al*, 1986 using the following equation:
*** NDF% = 28.924 + 0.657 (% crude fiber) **ADF%= 9.432 + 0.912 (%crude fiber)**
*** NDF = cellulose +hemicellulose +lignin **ADF = cellulose + lignin**
4. Hemicellulose (%) = NDF –ADF
5. Calculated according to Fekete (1987) using the following equation:
DE (kcal/kg)=[7.1(CP,g/kg)+12 (EE,g/kg)+5.59 (NFE,g/kg)-1801]

Dry matter intake (DMI), digestibility and nutritive values of tested diets:

. The obtained data (Table 3) indicated that dry matter intake ranged between 87.5 to 105.17g without significant differences among different dietary treatments. Also insignificant differences were detected between collared and uncollared rabbits .These results are in agreement with those of Ahmed *et al* (2005) and Dairo (2008).

Concerning nutrients digestibility coefficients, the highest significant ($p<0.05$) value for DM was (74.77%) recorded for group receiving (0.5 % DO+ 0.5 %DG, while the lowest value was (66. 93%) recorded with rabbits fed on 1.0% DO. Also, the highest CP digestibility coefficients were recorded with rabbits given 1.5 % DG, 1.5 % DO, 1 % DG and 0.5 % DO + 0.5 % DG diets, respectively, without significant differences among them, but they significantly higher ($p<0.05$) than those of control, 1.0 % DO and 0.75% DO + 0.75 % DG. Digestibility coefficient of CF was significantly ($p<0.05$) higher for rabbits fed 0.5 % DO + 0.5 % DG, than the other treated groups. The previous results are in agreement with those reported by El-Hindawy *et al* (2003) and Abdel-Azeem and Abdel-Reheem (2006).

As for the nutritive values of tested diets (Table 3) ,the highest TDN%, DE and ME Kcal/Kg diet were recorded with 0.5 % DO + 0.5 % DG which was significantly higher than those of 1.0 % DO and 1.5 % DO, but it was not significantly differed compared with control group, 1 % DG , 1.5 % DG, and 0.75% DO + 0.75 % DG . Regarding with DCP %, the highest DCP% values were recorded with 1.5 % DG, 1.5 % DO, 0.5 % DO + 0.5 % DG and 1 % DG without significant differences among them, but they were significantly ($p<0.05$) higher than those of 1.0 % DO, control and 0.75% DO + 0.75 % DG without significant differences among the latter ones. The improvements effect of DO or/and DG supplementation on nutrients digestibility and hence the nutritive values of tested diets may be due to the presence of natural substances in the DO or/and DG which enhanced the activity of enzymes responsible for the digestion of nutrients in the digestive tract (El-Hindawy *et al*, 2003) as well as increase beneficial microbial activity. These findings may suggest that these supplements render the feeds more available for utilization, either by affecting positively the population of microflora or improving feed utilization through slowing feed rate of passage through the digestive tract, which was reflected later in better absorption (Elelamei, 2001).

Coprophagy status effects:

All nutrients digestibility coefficients as well as nutritive values of tested diets are shown in (Table 3), for rabbits allowed for coprophagy practice (uncollared) showed similar digestibility and nutritive values like those prevented coprophagy. Similar trend was observed by Mekawy (2007).

Caecum pH and microflora:

Results in Table (4) showed that mean of pH values for rabbits received control diet was insignificantly higher than those of the other dietary treatments. pH values of caecum appendix content are within the normal ranges reported by Lebas *et al* (1997). Similar trend have been reported by Abdel –Azeem and Abdel-Reheem (2006).

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Table (4): Least square means ±SE of some factors affecting Caecum activity of rabbits for the experimental diets.

Treatments	Caecum activity			
	pH	Bacterial total count**	E.coli total count	Salmonella and shigella
T1 Control diet	6.13±0.040	23.50±6.87^{e}	ND	ND
T2 (1% DO)	5.94±0.040	27.50±6.87ed	ND	ND
T3(1.5% DO)	5.85±0.040	172±6.87b	ND	ND
T4(1% DG)	5.89±0.040	300.25±6.87a	ND	ND
T5(1.5% DG)	5.95±0.040	47.50±6.87d	ND	ND
T6(0.5% DO+0.5 %DG)	5.93±0.040	85.00±6.87c	ND	ND
T7(0.75% DO+ 0.75% DG)	5.89±0.040	32.50±6.87ed	ND	ND

a, b, c, d, e, f and g Means with the same letter within each column are not significantly different.
SE=Standard error
ND=not detected
**** No. of bacterial cells / gm of caecum content (total count × 10^5)**

Rabbits fed diet containing 1.0 % DG recorded the highest means ($p<0.05$) of total bacterial count of caecum appendix contents followed by those given 1.5 % DO or 0.5 % DO + 0.5 % DG. The lowest means of total bacterial count were recorded by rabbits received control diet. The *E.coli* and *Salmonella* and *Shigella* counts seem to be undetected in all dietary treatments including control group (Table, 4). This may be due to the inclusion of the tested additives (garlic or onion) in rabbit diets, which contain active compounds such as allicin, quercetin, aflavonoid (one category of antioxidant compounds), (Abou EL-Wafa *et al., 2002).* As well as they are rich in fructo-oligosaccharides which can selectively influence the intestinal microflora by either encourage the growth of beneficial bacteria and inhibit pathogenic species. The absent of the E.coli and *Salmonella* and *Shigella* bacteria in control group could be hardily explained on the light of the obtained results with other dietary treatments.

Conclusion

It could be concluded that the tested botanical feed additive (dried onion or / and dried garlic) had a positive influence on most of digestibility coefficients and nutritive values of tested diets as well as showed healthy caecum activity of NZ W rabbits. The best level was mix of dried onion and dried garlic at 0.5% for each followed by 1.5% dried onion and 1.5% dried garlic.

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تاثير اضافه مستويات مختلفه من البصل والثوم المجفف ومخاليطهم على معاملات الهضم وظاهرة الاجترار الكاذب Coprophagy ونشاط الاعور فى االأرانب

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1- كليه الزراعه - بمشتهر جامعه بنها

2- كلية الزراعه - جامعه المنصوره

اجريت هذه الدراسه بمحطه تجارب قسم الانتاج الحيوانى – كليه الزراعه بمشتهر – جامعه بنها وقد استخدمت فى هذه الدراسه عدد 42 ذكر نيوزلندى تم توزيعها عشوائيا الى 7 مجموعات 6 ذكر (3 بطوق و 3 بدون طوق) كالتالى : 1- المجموعه الاولى تغذت على العليقه الكنترول 2- المجموعة لثانيه تغذت على العليقه الكنترول مضافه اليها % 1 من البصل المجفف , 3- المجموعه الثالثه تغذت على العليقه الكنترول مضاف اليها 1.5 بصل مجفف ,4- المجموعه الرابعه , تغذت على العليقه الكنترول مضاف اليها 1 % ثوم مجفف ,5- المجموعه الخامسه , تغذت على العليقه الكنترول مضاف اليها 1.5 % ثوم مجفف ,6- المجموعه السادسه , تغذت على العليقه الكنترول مضاف اليها 0.5 % بصل مجفف + 0.5 % ثوم مجفف ,7- المجموعه السابعه , تغذت على العليقه الكنترول مضاف اليها 0.75 % بصل مجفف + 0.75 % ثوم مجفف.

وتتلخص أهم النتائج فى هذه التجربه:

المأكول من الماده الجافه:

1- أشارت النتائج المتحصل عليها إلى عدم وجود فروق معنويه فى المأكول من الماده الجافه بين مجموعة الكنترول مقارنه بالمعاملات الاخرى.

2- أظهرت النتائج عدم وجود فرق معنوى فى المأكول من الماده الجافه بين مجموعة االأرانب التى منعت من ظاهرة الاجترار الكاذب Coprophagy مقارنه بالتى لم تمنع.

معاملات الهضم:

1- اتضح من النتائج المتحصل عليها عدم وجود فرق معنوى بين معاملات هضم كل من الماده العضويه OM والمستخلص الأثيرى EE والكربوهيدرات الذائبه NFE عندما تناولت االأرانب العليقه الكنترول مقارنة بتلك التى تغذت على العلائق الاخرى.

2- اظهرت النتائج وجود فرق معنوى لمعامل هضم البروتين بمجموعات الأرانب المغذاة على العليقه الكنترول مضافا" اليها 1.5 % ثوم و 1.5 % بصل ومخلوط من البصل والثوم بمستوى 0.5 % مقارنة بالكنترول والمجموعات الاخرى.

3- أدى اضافه مخلوط من البصل والثوم عند مستوى 0.5 % لكل منهما فى علائق االأرانب الى تحسن معنوى لمعامل هضم الالياف CF .

4- اشارت النتائج المتحصل عليها الى تحسن معنوى عند مستوى معنوية 5 % فى القيم الغذائيه (مجموع المركبات الغذائيه المهضومه TDN والطاقه المهضومه DE والطاقه الممثله ME عندما تناولت االأرانب عليقة الكنترول مضافا" اليها مخلوط البصل والثوم عند مستوى 0.5 % لكل منهما عند مقارنتها بتلك التى تغذت على 1 % بصل مجفف.

5- اوضحت النتائج المتحصل عليها عدم وجود فروق معنويه فى معاملات الهضم المختلفه (الماده الجافه DM والماده العضويه OM والبروتين الخام CP والدهون EE والالياف الخام CF و الكربوهيدرات الذائيه NFE) والقيم الغذائيه (مجموع المركبات الغذائيه

المهضومه TDN والطاقه المهضومه DE والطاقه الممثله ME) عند مقارنه مجموعه االأرانب التى منعت من ظاهرة الاجترار الكاذب Coprophagy بتلك التى سمح لها بالاجترار الكاذب (تناول الروث الطرى).

نشاط الاعور:

أدى ادخال الاضافات فى علائق االأرانب الى زيادة العدد الكلى من بكتريا الاعور مقارنه بالكنترول مع غياب البكتريا المرضيه (الايشريشيا كولاى والسالمونيلا والشيجلا) فى محتويات الاعور.

وعموما نستخلص من هذه الدراسه انه يمكن التوصيه بإضافه مسحوق الثوم و البصل إلى علائق االأرانب لتحسين الكفاءة الهضمية وصحة وسلامة الجهاز الهضمى ونشاط الأعور، وقد كانت أفضل المستويات المستخدمة المخلوط المكون من البصل والثوم عند مستوى 0.5 % لكل منهما يليه المستوى 1.5 % بصل و 1.5 % ثوم.

قام بتحكيم البحث

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Table (3): Least square means and standard errors for digestibility coefficients and nutritive values of the tested diets.

Items	Control diet (T1)	Levels dietary treatment						Coprophagy status		Standard errors		Significant levels	
		Level of dried onion (DO)		Level of dried garlic (DG)		Mixture of (DO and DG)							
		T2 (1%)	T3 (1.5%)	T4 (1%)	T5 (1.5%)	T6 (0.5%+ 0.5%)	T7 (0.75%+ 0.75)	Collared Rabbits	Un collared Rabbits	treatments	coprophagy	treatment	coprophagy
No. of rabbits	6	6	6	6	6	6	6	21	21				
Dry matter intake(DMI) g/h/d	105.17	100.83	91.33	87.5	101.83	88.67	92.83	94.96	96.14	4.99	2.67	NS	NS
Digestibility coefficients %													
DM	70.64^{abc}	66.93^{c}	68.81^{bc}	72.49^{ab}	71.63^{ab}	74.77^{a}	69.47^{bc}	71.27	69.93	1.53	0.82	*	NS
OM	71.36	68.19	69.73	73.13	71.66	74.96	71.02	72.04	70.83	1.45	0.77	NS	NS
CP	68.19^{b}	68.82^{b}	79.54^{a}	78.60^{a}	80.11^{a}	79.02^{a}	72.54^{b}	74.83	75.54	1.85	0.99	**	NS
CF	52.01^{bcd}	42.97^{d}	46.87^{cd}	56.52^{b}	56.22^{bc}	60.80^{a}	54.25^{bc}	51.41	55.64	2.98	1.59	**	NS
EE	76.81	74.36	78.69	71.29	75.96	71.43	71.09	74.22	74.23	2.76	1.47	NS	NS
NFE	77.89	75.62	72.82	76.27	73.13	76.46	75.54	75.9	74.87	1.51	0.81	NS	NS
Nutritive values%													
TDN [1]	66.92^{ab}	62.92^{b}	64.18^{b}	67.29^{ab}	66.98^{ab}	69.51^{a}	66.13^{ab}	65.73	66.19	1.35	0.72	*	NS
DCP	12.44^{b}	12.38^{b}	14.47^{a}	14.31^{a}	14.58^{a}	14.38^{a}	13.20^{b}	13.61	13.74	0.34	0.18	**	NS
DE [2]	2946.67^{abc}	2777.33^{c}	2853.17^{bc}	2981.00^{ab}	2972.17^{ab}	3076.00^{a}	2921.17^{abc}	2910.33	2954.66	59.08	31.58	*	NS
ME [3]	2828.66^{abc}	2666.17^{c}	2739.00^{bc}	2861.50^{ab}	2853.00^{ab}	2953.17^{a}	2804.33^{abc}	2793.9	2836.33	56.68	30.29	*	NS

a ,b and c means within each row with different superscripts are significantly (p<0.05) different. NS= not significant

1-Total digestible nutrient (TDN) was calculated according to the classic formula of (Cheeke *et al*, 1982) as follows:TDN%=%DCP+%DCF+%DNFE+%DEEx2.25

2-Digestible energy (DE) was calculated according to Schiemann *et al*., (1972) as follows: DE (Kcal/kg diet) =5.28 (DCP, g kg) + 9.51(DEE, g/kg) +4.20 (DCF, g/kg) + 4.20 (DNFE, g/kg)

3-Metabolizable energy (ME) was calculated according to (Pond *et al,* 2006) as follows: ME (in kcal/kg) =DE (in kcal/kg) x 0.96-(0.202 x protein %) / 100

Table (2): Chemical analysis of tested diets and natural feed additives (dried garlic DG and dried onion DO powder on DM basis %).

Items	Control diet (T1)	Levels dietary treatments						Chemical anlysisof dried garlic (DG)and dried onion (DO)powder	
		Levels of dried onion(DO)		Levels of dried garlic(DG)		Mixture of (DO)and(DG)			
		T2 (1%)	T3 (1.5%)	T4 (1%)	T5 (1.5%)	T6 (0.5%+0.5%)	T7 (0.75%+0.75)	Dried garlic powder	Dried onion powder
Dry matter (DM %)	91.09	91.12	91.16	90.96	91.20	91.15	91.06	92.76	92.40
Crude protein(CP %)	18.19	18.21	18.24	18.13	18.25	18.12	18.18	14.96	13.79
Ether extract (EE %)	3.13	2.89	2.85	2.93	2.88	2.79	2.95	0.25	0.68
Ash (%)	10.52	10.67	10.59	10.68	10.40	10.34	10.58	3.50	3.70
Organic matter (OM %)	89.48	89.33	89.41	89.32	89.60	89.66	89.42	96.50	96.30
Nitrogen free extract (NFE)	52.38	52.42	52.56	52.47	52.73	52.95	52.54	76.02	78.95
DE(Kcal /Kg diet)	2794.13	2768.99	2774.14	2770.90	2787.96	2780.23	2780.77	3540.68	3673.00
Crude fiber (CF %)	15.78	15.81	15.76	15.79	15.74	15.80	15.75	5.27	2.88
Neutral detergent fiber(NDF %)	39.29	39.31	39.28	39.30	39.27	39.30	39.27	32.39	30.82
Acid detergent fiber(ADF%)	23.82	23.85	23.81	23.83	23.79	23.84	23.80	14.24	12.06
Hemicellulose (%)	15.47	15.46	15.47	15.47	15.48	15.46	15.48	18.15	18.76