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Effect of Broccoli Stem and Leaves on Milk Production and it is Compositions in Cross Bread Frisian Dairy Cattle

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Abstract
This study has been accomplished in Grdarasha fields, College of Agricultural Engineering Sciences, Salahadin University, Erbil. Kurdistan Region, Iraq. The goal was to investigate the effect of using broccoli leaves and stems instead of green fodder in different proportions (2, 4 and 6) kg/day per treatment respectively on quantity of milk production and its composition in Frisian cross bread in Erbil Governorate. With concentrated ration that includes (barley, soya bean meal and wheat bran). A total 3 cows were used in this research. PROC GLM (General Linear Model) procedure in SAS (2004) was used to analyze the data for milk production and compositions. The cows were divided in to 3 groups, each group of 1 cow, and each cow given same concentrate ration. Barley straw was given to the cow's ad libtum, the experiment lasted 9 weeks divided into 3 periods (3 weeks each). 1st and 2nd weeks were considered introductory stages, 3rd week was an experimental stage where the produced milk was measured daily (morning and evening). Milk samples were taken from each cow in the last 2 continuous days of the experimental stage for chemical analysis. Cows ate similar amounts of dry matter, with all treatments.
Results indicated the following:
1- There is a significant differences ($p \leq 0.05$) among treatments in average daily milk production that was 10.817, 11.103, 10.202 kg/day for the 1st, 2nd& 3rd treatments respectively.
2- As for milk composition, result showed significant increase ($p \leq 0.05$) in fat% for 1st treatment if compared with 3rd.
Result of this research showed significant milk protein% in 2nd treatment if we compared with 3rd treatment.
Results indicated that were a significant increase in daily milk lactose between 3rd treatment if we compared with 1st and 2nd treatments.
The results also showed significant differences between 3rd and 2nd treatments in S.N.F.

Keywords: Dairy Cattle, broccoli wastes, daily milk production, milk composition.

Introduction
Dairy cattle feeding specialists have conducted experiments and studies to develop models of nutrients that provide adequate amounts of the necessary nutrients in the diet to obtain the largest results of those studies (N.R.C 1985).
Because of the currently increasing cost of protein feed ingredients, this effort were carried out to use untraditional feed ingredients to participate in facing protein shortage problem and to decrease the feeding costs as well.(YasmimM.M.Mahmoud 2016). Broccoli leaves and stems that belonging to the family Brassicaceae used as untraditional feed ingredients in the form of dried whole plant (Ahuja et al., 2011). Broccoli is a rich source of chemo protective molecules including glucosinolates,
which considered a class of organic compounds that contain sulfur and nitrogen (Omirou et al., 2009).
Many studies have focused on extracting bioactive metabolites from the edible parts of broccoli

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(Assad et al., 2014; Mahn et al., 2014), extending the shelf life and maintaining the visual quality and content of bioactive compounds in broccoli florets (Peng et al., 2015). Broccoli (Brassica oleracea) is a popular vegetable because of its attractive green color and high nutritional value (Martínez-Villaluenga et al., 2008). The byproducts (in kurdstan about 1000, tons of leaves and stems per year are left in the fields, leading not only to a waste of resources but also to a detrimental effect on the environment. There is widespread interest in developing nonconventional feedstuffs to replace concentrates (Wang et al., 2007; Lodge-Ivey et al., 2014).

(Yi et al.2008) found that broccoli byproducts were possibly a suitable feedstuff because of their high protein content and low cost. They found little effect on in vitro gas production (GP) and ruminal fermentation in ruminant diets after replacing SBM with pelletized broccoli residues. Because broccoli is rich in protein, vitamins and phenolic (Martínez-Villaluenga et al., 2008), utilization of Broccoli byproducts (Bb) as a source of concentrates for livestock may be beneficial to both animal production and the environment. However, little information is available on the effects of replacing concentrate mixture with PBB. Therefore, the objective of the present study was to evaluate the effects of using (Bb) the lactation performance and milk composition of dairy cows.

Materials and Methods

Recently, recovery and bioconversion of vegetables residues to high-value compounds has been receiving great attention(Mahro and Timm 2007) Presents an alternative to utilize the broccoli wastes produced in the field, which constitutes the largest volume of vegetable and represents a problem for the farmer, with respect to its handling and disposal. (Olga et al. 2009).

Feed and chemical materials used in experimental diets:

Concentrated and roughage fodder materials: black barley, soybean meal, Wheat bran and hay.
Green fodder: broccoli wastes (leaves and stems).
On the basis of the results of the chemical analysis, a basic diet of equal content of crude protein (16%) was prepared.

Models of feed materials

First: Before the formation and mixing of the experiment ration, representative samples were taken from all the forage materials (which made up the concentrated diet). Also, samples were taken from the hay for the purpose of conducting chemical analyzes and determining the proportions of the nutrients for each of them before the mixing process.

Second: In this experiment, a standardized concentrated diet was used, consisting of 75% crushed barley, 14% of soybean meal, 10% of wheat bran, 0.5% limestone, 0.5% salt and 0.1% vitamins. Also, three different levels of leaves and stems broccoli residues were used in proportions of (2, 4 and 6 kg), respectively.

The experiment consisted of three treatments. The duration of each treatment consisted of (21) days consisting of (15) days a preliminary period, followed by (7) days.

Experiment animals

This experiment was conducted with (3) cross breed Friesian cows in the third milk

season, where the cows were placed in individual barns, each barn containing their own feeders and drinkers. The milking process was performed twice a day at (8) in the morning and at (5) in the evening. The concentrated feed was provided (10 Kg) on two meals a day after morning and evening milking (5kg for each meals), with hay being provided freely until satiety (Ad libitum). Cows were similar in weight, age and season of milk production, as shown in Table (1).

Table (1) Body weight, Parity, milk production rate, fat percentage of the experimental cows

Cow number	body weight/ kg	Parity	daily milk production / kg	milk fat%
1	420	3	9	3.4
2	430	3	9	3.4

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3	450	3	10	3.1

Veterinary care

The cows were examined by the veterinarian of the project in order to ensure their safety from diseases, and the cows were treated according to the preventive program followed in the project, where the animals were vaccinated with preventive vaccinations against communicable and infectious diseases spread in the area. All the cows were free of external diseases and reproductive defects.

Experience barns

Tree barns with dimensions (4 x 4 m) were used with fixed feeders made of cement and drinkers made of iron. After the feeding treatments were distributed, the cows were randomly distributed to the barns so that each cow became an independent treatment.

Chemical analyzes of feed materials and concentrated diets

The chemical analysis was carried out for the experiment stoichiometry According to (AOAC, 1980), as shown in Table (2), the nutritional requirements of cows were calculated. According to (NRC, 1989), based on body weight, daily milk yield and fat percentage Milk and the milk components were analyzed by (Toto milk Eco) device,

The broccoli wastes were ground to pass through a 1-mm sieve for subsequent analysis. The DM contents were determined according to method No. 942.05 (AOAC, 1997). The samples were analyzed for crude protein (CP) (method 988.05), acid detergent fiber (ADF) (method 973.18, AOAC, 1997) and neutral detergent fiber (NDF) by the method of (Van Soest et al., 1991). Amylase, but not sulfite was used in the determination of NDF. Both NDF and ADF were expressed exclusive of residual ash.

The forage material samples mentioned above were analyzed according to what was stated in the analyzes of (AOAC, 1980) for the analyzes of various forage materials in order to estimate the proportions of dry matter, crude protein and ash in the experimental diets, Table (2),(3) and (4).

Table (2) Chemical analysis of forage materials used in feeds% Experience

Feed	dry matter	Crude protein	Crude fiber	Ash
Barley	93.5	11.73	6.05	2.35
soybean meal	93.35	47.11	34.45	6.50
Hay	94.6	4.17	32.01	11.41

Table (3) chemical analysis of the concentrated suspension

Type of examination	The result	Analysis reference
Protein	17.6	IR 600(kjeldahl)
Ash	4.7	ISO 5984
Humidity	8.64	By Oven (Memmert)
Fat	0.7	ISO 6492 EEG
Crude fiber	6.3	ISO 5498/1981

Table (4) chemical analysis of the broccoli wastes (leaves and stems).

Type of examination	The result	Analysis reference
Protein	3.44	IR 600(kjeldahl)
Ash	2.6	ISO 5984

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Humidity	79.8	By Oven (Memmert)
Fat	2	ISO 6492 EEG
Crude fiber	3.7	ISO 5498/1981

Take samples from milk

Samples of milk produced from each cow were taken on the last two days of the end of each of the three experimental periods. Samples were taken from the evening and morning at a rate of 10% of the daily production Milk yield per day was calculated by adding the milk yield of the second milking in the evening to that of the first milking in the morning. Were kept in the refrigerator at (4 ° C) and then mixed with the milk samples taken from the morning .The analyze are: (Fat, protein, lactose, and total solid not fat percentage).

Statistical Analysis:

The PROC GLM (General Linear Model) procedure in SAS (2004) was used to analyze the data for milk production and compositions. Fixed effects study was effect of three level of Broccoli (2, 4 and 6 kg/day) fitted in the following model:

$Yij(k) = \mu + Ci + Pj + \tau(k) + \varepsilon ij(k)$ $i,j,k = 1,...,r$ Where:

$Yij(k)$ = milk production (kg) and milk compositions (%).

μ = the overall mean

Ci = the effect of cow i

Pj = the effect of period j

$\tau(k)$ = the fixed effect of treatment k

$\varepsilon ij(k)$ = random error with mean 0 and variance $\sigma 2$

r = the number of treatments, cows and periods and variance Duncan's multiply range was used to determent the difference between means.

Results and Discussion

The results showed that there were significant differences in the rate of daily milk production at ($p \leq 0.05$) between the second treatment and the third treatment, which was (11.103, 10.202) kg/day respectively. Also result showed us there is an arithmetic difference between second (11.103kg/day) and first (10.817kg/day) treatments table (5).While disagree with results obtained by (X. W. Yi, et al., 2015) they found no significant increase in daily milk yield in a study to determined the effects of feeding pelletized broccoli byproducts (PBB) on milk yield and milk composition in dairy cows. The reason for this increase in the amount of milk production for the second treatment compared to the first can be due to the fact that the amount of broccoli residues in this treatment, which was 4 kg, opened the cow's appetite for eating larger quantities of concentrated feed, as well as the percentage of water in this amount Broccoli waste caused an increase in daily milk production compared to the first treatment, which was 2 kg of broccoli waste per day.

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Table (5) Mean ± SE effect of Broccoli byproduct on total milk production (kg/day).

Treatments	Milk production Mean ± S.E
T1 (2kgBb)	10.817 ± 0.171 a
T2 (4kgBb)	11.103 ± 0.187 a**
T3 (6kgBb)	10.202 ± 0.183 b

** It means there are significant at ($p \leq 0.05$)

As for the composition of the milk, the results showed a significant increase ($p \leq 0.05$) in the percentage of milk fat for the first treatment 2kg broccoli leaves and stems if we compared with the third treatments 6kg broccoli leaves and stems in the fat percentage it is (2.926% , 2.400%) respectively table (6)the result of this study were agree with results obtained by (X. W. Yi, et al., 2015) they found significant increase in milk fat in a study to determine the effects of feeding pelletized broccoli byproducts (PBB) on milk yield and milk composition in dairy cows , including PBB significantly increased the percentage of milk fat ($p \leq 0.05$). While the percentage of fat increased in the second treatment (2.435%) but didn't differ significantlyif we compared with the third treatment (2.400%) Also there is no significant effect between the first treatment (2.926%) and the second treatment (2.433%).In spite of the presence of arithmetic differences. The reason due to the fact that the percentage of milk fat increases as the milk production decreases because there is an inverse relationship between milk production and milk fat.

Table (6) Mean ± SE effect of Broccoli byproduct on milk composition in Frisian cross breed cow.

Treatments	Fat	Protein	Lactose	S.N.F
T1 (2kgBb)	2.926± 0.219 a*	3.218±0.049 ab	4.421±0.078 b	8.295±0.116 ab
T2 (4kgBb)	2.435± 0.167 ab	3.130±0.020 b	4.348±0.017 b	8.113±0.048 b
T3 (6kgBb)	2.400± 0.097 b	3.264±0.040 a*	4.633±0.011 a**	8.494±0.094 a*

*It means there are significant at ($p \leq 0.05$).

** It means there are significant at ($P \leq 0.01$).

The different letters in each column means there are significant.

On the other side the percentage of milk protein significantly exceeded ($p \leq 0.05$) with the second treatments (4kg) broccoli leaves and stems it become (3.13%) if we compared with the third treatments (6kg) broccoli leaves and stems was (2.264%) table (6) this result was disagree with the result of (X. W. Yi, et al., 2015) were they founded no significant effects on the percentages of milk protein .The reason may be attributed to the fact that the rate of utilization of protein in the second treatment and bacterial protein increases when it passes into the small intestine and is decomposed there to produce amino acids, and this in turn has a direct effect on increasing the proportion of protein in milk.

The results also showed significant differences in milk lactose ($P \leq 0.01$) between the third

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treatment (4.633%) if we compared with the first (4.421%) and the second (4.348%) treatments table (6), this results also showed no significant increase in milk lactose percentage between the first (4.421%) and second (4.348%) treatments the reason for the similar content of lactose in milk is that lactose is one of the less changed components of milk.

As for S.N.F in milk the result also show us there is a significant differences between the third treatment and the second treatment it is (8.494%, 8.113%) respectively this reason due to an increase in the proportion of protein and lactose in the third treatment compared to the second treatment, table (6) this result was disagree with the result of (X. W. Yi, et al., 2015) were they founded no significant effects on the percentages of lactose, total solids and solids-not-fat ($p>0.05$). in a study conducted to determine the effects of feeding pelletized broccoli byproducts (PBB) on milk yield and milk composition in dairy cows.

CONCLUSION

Giving 4 kg of broccoli leaves and stems daily instead of green fodder leads to an increase in daily milk production as well as improves the proportion of milk fat and protein. Therefore, we recommend giving this amount of broccoli residues to dairy cattle for the purpose of increasing milk production and improving the proportion of milk components in general. The increased use of PBB in the future would be beneficial for developing a more efficient use of resources, and make ruminant milk.

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