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Effect of Dietary Pomegranate Peel (*Punica granatum*) Supplementation on Milk Production and Quality of Labneh of Friesian Dairy Cows

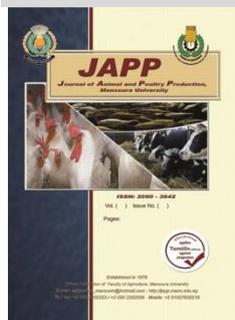
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ABSTRACT



This study was conducted to investigate the effect of adding different levels of pomegranate peel (2, 3 and 4%) to dairy cows diets on milk production, chemical composition and quality of labneh. Sixteen crossbred Friesian cows (3rd – 4th season) the first week of lactation were randomly chosen and divided into four groups (4 cows in each group) Latin square design (4x4) (28 days for each period). The groups were fed the following rations: (1) control ration (40% concentrate feed mixture + 40% corn silage + 20% rice straw), (2) control ration + 2% pomegranate peel. (3) control ration + 3% pomegranate peel, and (4) control ration + 4% pomegranate peel. The rations were formulated according to NRC (2001). The results show that diet containing 2% of pomegranate peel increased ($P < 0.05$) the milk 4% FCM production. The use of pomegranate peels with the cow rations up to 2% to have higher yield of labneh with keeping the quality acceptable for the consumers. This study concluded that pomegranate peels at the level of 2% can be used for dairy cow rations to increase milk yield of dairy cows without any harmful effects health status of animals. Therefore, Further long-term studies on lactating animals are required to confirm the obtained results.

Keywords : Pomegranate peel, milk production, lactating cows, labneh quality.

INTRODUCTION

Natural increase in population undoubtedly associates with increase demands for animal products. This case prompts serious search for alternative feeds and improves utilization of the available sources in order to diminish the expected gap between ruminant requirements and currently used diets, taking in consideration that depending on concentrates should be reduced (Santos *et al.*, 2010). However, healthy diets with high nutritive values are very important to produce quality and economic animal products (Sakhawat, 2011). Pomegranate characterized with high tannin content, especially the peel which is about 25-28% (Li *et al.*, 2006). Tannin may help to improve ruminant productivity by increasing flow of true protein from the rumen and enhance feed digestibility due to protected effect of ruminal degradability of dietary protein (Mirzaei-Aghsaghali *et al.*, 2011). Also, most of these compounds are potent free radical scavengers that could favorably affect the antioxidant status of the animal (Liu *et al.*, 2016). Phenolic compounds in pomegranate, which have high correlation with disease-fighting compounds and natural antioxidant capacity, help to maintain human health to preventing diseases (Akhtar, *et al.*, 2015).

Different pomegranate components appear to have various effects on the feed intake, nutrient digestibility, and milking performance of cows. Although polyphenolic compounds might improve animal health, they can also decrease proteolytic activity and thus compromise protein digestion (Broderick *et al.*, 1991).

The objective of this study is to investigate the effect of addition of pomegranate peel at different levels on milk production and quality of labneh in lactating Friesian cows.

MATERIALS AND METHODS

The experiment was carried out at El-Noubari Research Station, Animal Production Research Institute, Egypt. Sixteen lactating crossbred Friesian cows (536.38 kg live body weight, LBW) with 3-4 parities were used in this study. At the first week of lactation experimental animals were allocated into 4 similar groups based on their average LBW and average daily milk production (8-10 kg) of the previous season. Duplicated Latin Squares design (4 cows x 4 diets) was used. The four cows of each group were fed the four tested diets for 28 days (21 d as a preliminary interval and 7 d as a collection interval). Cows were fed the four experimental rations formulated as the following: (1) control ration (40% concentrate feed mixture + 40% corn silage + 20% rice straw without adding pomegranate peel, (2) control ration + 2% pomegranate peel, (3) control ration + 3% pomegranate peel, and (4) control ration + 4% pomegranate peel.

Cows were individually fed according to NRC (2001). Animals were milked by using an automated twice daily for each cow at evening and morning, then milk yield was recorded individually on two successive days. Milk samples (100 ml) were taken from the two consecutive milking according to Galatov (1994). Milk samples were chemically analyzed for fat, protein, total solids (TS), and ash according to AOAC (2007). Fat corrected milk (4%)

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was calculated according to Gaines (1923) using the following equation: 4 % FCM = 0.4 x milk yield (kg) + 15 x fat yield (kg).

About 12 kg fresh milk were taken from morning milking of each group to make (labneh). Labneh is defined as yoghurt like cheese, which is highly accepted by many Arab countries especially Syria, Lebanon and Jordan. The first step in labneh processing is yoghurt making by heating the milk individually up to 80 °CF for 20 minutes followed by cooling to 44°C, inoculating by 1% commercial yoghurt culture, let into incubator at 42± 2°C for about 3 hours to have firm coagulant. Time of complete coagulation is correctly scored. The coagulum was left at refrigerator at 42±2°C for 18 hours. About 1.5% common salt was separately added to the cold yoghurt and well stirred, then filled into cloth bags, hanged overnight to get rid of the whey. Each labneh is individually weighed to get rid of the whey. Each labneh was weighed to calculate the yield.

Sensory evaluation:

Fresh unknown samples of labneh were donated to the 10 judges for the sensory evaluation, 10 scoring points for color and appearance, 40 for body and texture and 50 for flavor

organoleptic evolution

| | |
|----------------------|----|
| color and appearance | 10 |
| body and texture | 40 |
| flavor | 50 |

Labneh Yield

Labneh Yield was calculated as =

$$\text{kg of resultant labneh} / \text{kg of milk used} * 100$$

Data were analyzed by one way analysis of variance (Completely Randomized Design) according to the General Linear Models (GLM) procedures of SAS (2000). The difference among means was determined by least significant difference (LSD).

RESULTS AND DISCUSSION

Chemical composition of CFM, corn silage, rice straw and pomegranate peel (Table 1) revealed high CP content in CFM and corn silage. Also, corn silage, rice straw and Pomegranate peel contained high CF. Pomegranate

peel contained high total phenolics and NFE contents. It could be noticed that the CP% for CFM showed more double value of corn silage. However, they were normally equal in EE, ash and NE.

Table 1. Chemical composition of experimental ingredient

| Ingredient | CFM | Corn silage | Rice straw | Pomegranate peel |
|---------------------------------------|-------|-------------|------------|------------------|
| Analyzed composition % | | | | |
| DM | 89.83 | 30.24 | 89.54 | 87.52 |
| OM | 94.59 | 94.56 | 92.45 | 94.34 |
| CP | 16.21 | 8.03 | 3.41 | 3.58 |
| CF | 6.84 | 23.52 | 30.63 | 12.16 |
| EE | 2.71 | 2.49 | 1.08 | 1.87 |
| NFE | 68.83 | 60.52 | 57.33 | 76.73 |
| Ash | 5.41 | 5.44 | 7.55 | 5.66 |
| Net energy of lactation (M cal/kg DM) | 0.59 | 0.62 | 0.58 | 0.58 |
| Pomegranate-peel extract, mg TP/g DM | | | | |
| Total phenolics (TP) | | | | 74.33 |
| Saponins | | | | 33.76 |
| Total tannins | | | | 52.19 |

Milk production and its composition

Fat corrected milk yield (4% FCM), TS, SNF and protein were significantly (P<0.05) higher with 2% pomegranate peel than with other levels of pomegranate peel and control ration (Table 2). In disagreement with the present results, Benchaar *et al.* (2008) found insignificant effect of Cinnamaldehyde, queb-racho condensed tannin and Yucca schidigera saponin extracts on actual and 4% FCM milk yield of lactating cows. Although addition of 4% pomegranate peel in the ration significantly (P<0.05) decreased milk production in the present study, Jami *et al.* (2012) reported that using 4% pomegranate peel extract as DM in dairy cows diet increased milk production. The observed increase in daily milk protein yield of cows fed pomegranate peel extract at a level of 2% may be due to an increase in the flow of microbial protein to the intestine, benefiting the cows by increasing the amount of amino acids available for absorption (Makkar,2003).

Table 2. Effect of different levels of pomegranate peel supplementation on feed intake, milk yield and its constituents of lactating cows.

| Items | Control | Pomegranate peel | | | SEM | P-Value |
|------------------------------|--------------------|--------------------|--------------------|--------------------|-------|---------|
| | | 2 % | 3 % | 4 % | | |
| Body weight of cows, kg | 537.25 | 532.75 | 540 | 535.50 | 27.55 | 0.738 |
| Production (kg/ day) : | | | | | | |
| Actual milk | 13.61 ^b | 14.18 ^a | 13.50 ^b | 12.23 ^c | 0.41 | 0.001 |
| Fat corrected milk (4%, FCM) | 11.65 ^b | 12.78 ^a | 11.54 ^b | 10.38 ^c | 0.37 | 0.001 |
| Fat | 0.414 ^b | 0.474 ^a | 0.409 ^b | 0.366 ^c | 0.01 | 0.017 |
| Protein | 0.412 ^b | 0.462 ^a | 0.402 ^b | 0.353 ^c | 0.02 | 0.021 |
| Milk composition (%): | | | | | | |
| Total solids | 10.47 | 10.75 | 10.41 | 10.39 | 0.46 | 0.647 |
| Solid not fat | 7.43 | 7.41 | 7.38 | 7.40 | 0.09 | 0.908 |
| Fat | 3.04 ^b | 3.34 ^a | 3.03 ^b | 2.99 ^b | 0.11 | 0.039 |
| Protein | 3.03 ^b | 3.26 ^a | 2.98 ^b | 2.89 ^b | 0.10 | 0.021 |
| Lactose | 3.62 ^a | 3.34 ^b | 3.55 ^a | 3.67 ^a | 0.12 | 0.042 |
| Ash | 0.78 | 0.81 | 0.82 | 0.85 | 0.08 | 0.744 |

^{a,b,c}: Means in the same row followed by different superscripts are significantly (P<0.05) different.

**Quality of Labneh .
yoghurt production.**

Table(3) shows that acidity%(than for 4%), fat%(than for 2%) and protein% were increased in all treatments, respectively than the control , These results maybe to increase of peels of pomegranate to the cow ration.

The increase of acidity is a result of conversion of lactose to acitic acid. Özer *et al.*(2007) and Ranathunga and Rathanayaka (2013) reported that the enzyme activity of starter bacteria used in labneh production resulted in significant increase in acidity, Fat % and protein% were slight increase maybe to peels of pomegranate Composition and addition ratio.

Time of yoghurt production (coagulation) decreased by the addition of peels of pomegranate to the cow ration. As the percentage of peels increased, time for complete coagulation decreased especially for 2% and 3% pomegranate to the cow ration . This decrease is may be due to the little increase of resultant total solids of milk especially the protein. The higher amount of peels in ration had little effect on decreasing the time of coagulation and acidity development. (Heena Jalal,*et al.*,2018). Labneh is organoleptically evaluated well trained judges from Nobarria Research Station. Table (3).

Table 3. Effect of different levels of pomegranate peel supplementation on calculated time for yoghurt production of lactating cows.

| | Control | Pomegranate peel levels | | |
|-------------------------------|--------------------|-------------------------|--------------------|--------------------|
| | | 2 % | 3 % | 4 % |
| Acidity | 0.76% ^c | 0.82% ^b | 0.88% ^a | 0.78% ^c |
| Fat% | 3.50 ^c | 3.60 ^b | 3.70 ^b | 4.20 ^a |
| Protein% | 2.92 ^d | 3.14 ^c | 3.29 ^b | 3.80 ^a |
| Time for coagulation(minutes) | 184 ^a | 178 ^c | 171 ^d | 180 ^b |

^{a,b,c} means in the same row followed by different superscripts are significantly (P<0.05) different.

The yield of the product is the target of producers which turned into raising his profit. From table (4) the addition of pomegranate peels 2,3and4% to cow ration slightly increased the yield of labneh 3.250; 3.371 and 3.391 respectively than the control (3.185). Due to increasing the content and yield of total solids in milk. Heena Jalal,*et al.*,2018). The rate of increase relative to control was significantly (P<0.05) higher 2, 4.8 and 6.5 by increasing percentage of peels 2, 3 and 4%, as tabled of Table (4).

The yield of the product is the target of producers which turned into raising his profit. From table 4 the addition of pomegranate peels to cow ration increased the yield Labneh, since total solids of milk increased as well the yield of Labneh increased. The percentage of increase was higher as the percentages of peels were increased. Still the question about the acceptability of the product. Table (4).

Table 4. Effect of different levels of pomegranate peel supplementation on calculated yield of Labneh of lactating cows.

| | Control | Pomegranate peel levels | | |
|------------------------|--------------------|-------------------------|--------------------|--------------------|
| | | 2 % | 3 % | 4 % |
| Kgm milk | 12 | 12 | 12 | 12 |
| Kgm LABNCH | 3.185 ^a | 3.250 ^a | 3.371 ^a | 3.391 ^a |
| Yield% | 26.54 ^a | 27.12 ^b | 28.14 ^c | 28.26 ^c |
| Percentage of increase | - | 2.0% ^a | 4.80% ^b | 6.50% ^c |

^{a,b,c} means in the same row followed by different superscripts are significantly (P<0.05) different.

Organoleptic evolution of Labneh

Fresh unknown samples of Labneh were donated to the 10 judges for the sensory evaluation, 10 scoring points for colour and appearance , 40 for body & texture and 50 for flavour. The average opinion of the judges are summarized and tabulated in table (5).

The yellow colour of cows milk was similar for the four samples, while the appearance of 4% pomegranate peel supplementation was not highly accepted by the judges , the curd was not sticky an compact , the texture was more firm for 2% and 3% pomegranate peel supplementation as compared with control treatment . 4% pomegranate peel supplementation had loose and breathe texture not similar to control Labneh.

The typical flavour milk attraction clean acidity was for control, 2% and 3% pomegranate peel supplementation, while 4% pomegranate peel supplementation gave strange flavour tend to bitterness.

Table 5. Effect of different levels of pomegranate peel supplementation organoleptic evolution of Labneh of lactating cows.

| | Control | Pomegranate peel levels | | |
|-------------------------|-----------------|-------------------------|-----------------|-----------------|
| | | 2 % | 3 % | 4 % |
| Colour & appearance(10) | 9 | 9 | 8 | 7 |
| Body & texture (40) | 36 ^b | 38 ^a | 38 ^a | 32 ^c |
| Flavour(50) | 45 ^a | 46 ^a | 46 ^a | 40 ^b |
| Total (100) | 90 ^b | 93 ^a | 92 ^a | 79 ^c |
| remarks | Typical texture | Compacted texture | Compacted | Loose texture |

^{a,b,c} means in the same row followed by different superscripts are significantly (P<0.05) different.

CONCLUSION

Form those results, it can be use 2% pomegranate peel in ration formulation of Friesian cows increased milk yield with no adverse effect on animals and have higher yield of Labneh with keeping the quality and the acceptance of the consumer.

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تأثير إضافة قشر الرمان (يونيكا جرانيتيم) للعليقة على إنتاج الحليب وجودة اللبن في الأبقار الفريزيان الحلابية

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أجريت هذه الدراسة لمعرفة تأثير إضافة مستويات مختلفة من قشور الرمان (3، 4%) لعلائق الأبقار الحلابية على انتاج اللبن والتركييب الكيماوى وتصنيع الالبان وانتاج اللبن . وقد استخدم 16 بقرة فريزيان خليط حلابية فى الموسم الثالث أو الرابع بتصميم المربع اللاتينى وقسمت الى اربعة مجموعات كل مجموعة تحتوى على 4 بقرات وقد غذيت المجاميع على العلائق التالية 1- عليقة مقارنة (40% علف مركز + 40% سيلاج انزرة + 20% قش الارز بدون اضافة قشور رمان) 2- عليقة مقارنة + 2% قشور رمان 3- عليقة مقارنة + 3% قشور رمان 4- عليقة مقارنة + 4% قشور رمان. وقد أظهرت النتائج ما يلى: ان العليقة المحتوية على مستوى 2% من قشور الرمان ادت الى زيادة فى معدل انتاج اللبن ودون اى تأثير صحى سلبى على الحيوانات مع تحسين جودة اللبن مع الحصول على جودة واستساغة عالية عند تصنيع اللبن. ونستخلص من هذه الدراسة الى انه يمكن استخدام قشور الرمان بمستوى 2% أو 3% لعلائق الأبقار الحلابية لتحسين الاداء الانتاجى للأبقار الحلابية نون حدوث أى ضرر على انتاجية وصحة الحيوانات مع تحسين جودة اللبن مع الحصول على جودة واستساغة عالية عند تصنيع اللبن على ان يوصى بمزيد من الدراسات على المدى الطويل على حيوانات اللبن لتأكيد النتائج المتحصل عليها فى الدراسة الحالية.