Hayvansal Üretim 58(1): 28-32, 2017

Araştırma / Research Article

The Use of Shelf Life Ended Food as Alternative Feedstuff Sources in Ruminant Feeding

Firdevs KORKMAZ, Sibel SOYCAN ÖNENÇ*

University of Namık Kemal, Faculty of Agriculture, Department of Animal Sciences, 59030,Tekirdağ, Türkiye

*İletişim (correspondence): e-posta ssonenc@nku.edu.tr ; Tel: +90 (282) 2502186 ; Faks: +90 (282) 2509929

Gönderim tarihi (Received): 28 Temmuz 2017; Kabul tarihi (Accepted): 23 Ağustos 2017

Abstract

The aim of this study is to reveal the possibility of pasta, pudding, wafer meal, ice cream- bran mixture, vegetable and yoghurt soups after determining their crude nutrient components and *in vitro* metabolic energy values. Samples were for 96 hour incubation under *in vitro* conditions according to Hohenheim Futterwerter Test (HFT). The amount of total gas production (GP) was recorded at the 3rd, 6th, 9th, 12th, 24th, 48th, 72th and 96th hours. Digestible organic matter (DOM), metabolic energy (ME) and net energy lactation (NEL) ingredients were predicted according to GP at the 24th hour. The GP differences among the samples were found statistically significant (P<0.05). When net GP amounts of the 24-hour-period were evaluated, the highest GP value was found out as 53.69 ml/ 200 mg DM in pasta, whereas the lowest value was found out as 25.76 ml/ 200 mg DM in ice-cream bran mixture. When DOM, ME, and NEL ingredients were calculated using GP amounts determined at the 24th hour, the highest value of DOM was found out (90.99%) in pasta, the highest value of ME was found out in pasta (12.31 MJ/kg DM), and the highest value of NEL was found out in wafer meal (8.73 MJ/kg DM). It has been concluded that pasta, pudding, vegetable and yoghurt soups, wafer meal and ice cream-bran mixture can be used as alternatives to ruminant rations, feedstuff sources rich in energy.

Keywords: Alternative feedstuff sources, ruminant feeding, ruminant fermentation, HFT

Raf Ömrü Biten Gıdaların Ruminant Beslemede Alternatif Yem Kaynağı olarak Kullanımı

Öz

Bu araştırmanın amacı, makarna, puding, gofret unu, dondurma-kepek karşımı, sebze ve yoğurt çorbalarının ham besin madde içeriklerinin ve *in vitro* metabolik enerji değerinin belirlenerek ruminant beslemede kullanılabilirliğini ortaya koymaktır. Raf ömrü biten örnekler Hohenheim Futterwerter Test (HFT) yöntemine göre *in vitro* koşullarda 96 saatlik inkübasyona bırakılmıştır. İnkübasyon süresince toplam gaz oluşum miktarları 3., 6., 9., 12., 24., 48., 72. ve 96. saatlerde ölçülmüştür. Örneklerde 24. saatteki toplam GO'ya göre organik maddelerin sindirim derecesi (OMS), metabolik enerji (ME), net enerji laktasyon (NEL) içerikleri hesaplanmıştır. Örnekler arasındaki GO farkları istatistiki olarak önemli bulunmuştur (P<0.05). Aynı zamanda net GO miktarları değerlendirildiğinde ise, en yüksek GO miktarı 53.69 ml/ 200 mg KM makarnada, en düşük ise 25.76 ml/ 200 mg KM dondurma-kepek karışımında bulunmuştur. Belirlenen GO miktarlarından yararlanılarak hesaplanılan OMS, ME ve NEL içerikleri incelendiğinde, en yüksek OMS değeri (90.99) sebze çorbasında belirlenirken en yüksek ME makarnada (12.31 Mcal/kg KM), en yüksek NEL ise gofret ununda (8.73 MJ/kg KM) bulunmuştur. Ruminant rasyonlarına enerjice zengin yem kaynaklarına alternatif olarak makarna, puding, sebze ve yoğurt çorbası, gofret unu ve dondurma-kepek karışımının kullanılabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Alternatif yem kaynakları, ruminant besleme, rumen fermantasyonu, HFT

Introduction

The increase of prices of raw material is a worldwide ongoing problem in animal nutrition. Considering the fact that feeding expenditures constitute 55-70% of total expenses of livestock farming, using with cheap and good quality feedstuff, increases the business profitability. Both price increase and insufficiencies of feedstuff as of amount and quality, the feed manufacturers and animal nutritionist to find new alternative feedstuff sources and to carry out researches about these sources (Vasta et al., 2008). Alternative feedstuff sources play an important role in reducing the feed costs by providing the substitution of feedstuff within the same nutrient group. On the basis of this thought, alternative feedstuff sources can be defined as affordable in comparison with each other or having some features of additional nutrients being prominent.

Alternative crude material is defined as the following:

1. Not being used previously or continuously
2. Nutrients being defined completely
3. Crude materials not being determined for their maximum addition ratio.

Facts like the rapid increase in world population, industrialisation, and increasing urbanisation bring about solid waste issues in developing countries, including Turkey. The system of waste management commonly used until today, and consisting of collecting, carrying and storage has become insufficient in cities. As well as being economically a burden in cities, the above mentioned system is also an important problem in terms of public health. Moreover, it is a lost economic value if not made use of it appropriately. Within this framework, 'Solid Waste Management' has become one of the indispensable components of 'Environmental Management' (Yılmaz and Bozkurt, 2010).

Food industry introduces us with various tastes every day. Waste as an outcome of this industry either during or after production, brings about several problems. Until today, the use of many industry wastes as animal feedstuff as an alternative of feeding alternatives has been investigated. The reference point of our study is that there are no researches previously made about using food as animal feedstuff in many farms that are actually used for human nutrition and reached the end of its shelf life.

The objective of this study is to reveal the possibility of pasta, pudding, wafer flour, ice cream-bran mixture, vegetable and yoghurt soups after determining their crude nutrient components and *in vitro* metabolic energy values.

Materials and Method

Material

This study complies with the ethic board rules at the time of investigation. The animal material consisted of fistulated Holstein Friesian cattle used previously in other studies. The food material consisted of human food such as pasta, pudding, wafer meal, ice cream-bran mixture, vegetable and yoghurt soups that have reached the end of their shelf life. Another feature of these foods is that they are included in the commercial waste group converted from domestic waste as well as being provided from a collector firm. These foods are to be in sustainable condition and more durable as dry food compared to fresh food.

Method

In this research, crude nutrient ingredients dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), crude ash (CA) were determined according to Weende (AOAC, 1990). Nitrogen-free extract was calculated by difference. In the determination of *in vitro* gas production (GP) was recorded at the 3rd, 6th, 9th, 12th, 24th, 48th, 72th and 96th hours, Hohenheim Futterwerter Test (HFT) or Hohenheim Feed Test developed in Germany at Hohenheim University were used (DLG, 1981). Moreover, the relation between GP and *in vivo* digestibility was determined as well. Variance analysis was used to evaluate the data statistically, and Duncan's Multiple Range Test was used to test the significance level among averages (Soysal, 1998). Statistical analysis was carried out via SPSS 15 programme.

Results and Discussion

Results

Crude nutrients and metabolic energy ingredients used in this research are given in Table 1. The CP, EE, CF, NFE, CA, and ME of pasta, pudding, vegetable soup, yoghurt soup, wafer meal, and ice cream-bran mixture in DM are found out to be 11.82, 4.38, 0.25,82.61, 0.94% and 3457.6 kcal/kg DM; 3.43, 5.84, 0.02, 89.54, 1.17% and 3480.1 kcal/kg DM; 9.27, 13.15, 0.57, 54.86, 15.16% and 3741.8 kcal/kg DM; 15.84, 7.79, 0.35, 47.86, 28.16% and 3591.9 kcal/kg DM; 4.75, 33.03, 0.06, 60.20, 1.96% and 4441.1 kcal/kg DM; 11.02, 8.87, 7.25, 65.81, 7.05% and 3329.3kcal/kg DM respectively. Starch and sugar ingredients are found out as 64.54 and 4.92%; 4.40 and 17.45%; 54.86 and 7.16%; 29.04 and 24.20%; 39.59 and 32.13%; 10.20 and 16.72% respectively.

Table 1. Nutrient ingredients (%) and metabolic energy values (kcal/kg) in dry matter

Sample	DM	CP	EE	CF	NFE	Starch	Sugar	CA	ME
Pasta	94.74	11.82	4.38	0.25	82.61	64.54	4.92	0.94	3457.6
Pudding	98.69	3.43	5.84	0.02	89.54	4.40	17.45	1.17	3480.1
Vegetable soup	95.29	9.27	13.15	0.57	61.85	54.86	7.16	15.16	3741.8
Yoghurt soup	93.94	15.84	7.79	0.35	47.86	29.04	24.20	28.16	3591.9
Wafer meal	87.15	4.75	33.03	0.06	60.20	39.59	32.13	1.96	4441.1
Ice cream-bran mix.	96.54	11.02	8.87	7.25	65.81	10.20	16.72	7.05	3329.3

DM: dry matter, CP: crude protein, EE: ether exract, CF: crude fiber, NFE: nitrogen free extract, CA: crude ash, ME: metabolic energy. ME, kcal/kg OM= 3260 + (0.455 x CP* + 3.517 x EE*) – 4.037 x CF (Anonyous, 1991).

Table 2. DOM, ME and NEL (MJ/kg DM) of Samples

Sample	DOM	ME	NEL
Pasta	90.99± 0.76^{a}	12.31± 0.15^{b}	6.68 ±0.10^{b}
Pudding	71.39±6.78^{b}	9.68 ±1.20^{c}	5.82±0.88^{cb}
Vegetable soup	91.83±2.33^{a}	11.61± 0.46^{b}	6.51±0.30^{b}
Youghurt soup	70.37±0.71^{b}	9.15 ± 0.14^{cd}	4.91±0.09^{cd}
Wafer meal	72.61± 2.29^{b}	15.09 ±0.45^{a}	8.73±0.29^{a}
Ice cream-bran mix.	89.89±1.36^{a}	7.8 ±0.27^{d}	4.01±0.18^{d}

*Means with different letters in the same columns are statically significant (P<0.05).
DOM, concentrate feed % = 1.88+ 0.8893*GP+0.0448* CP+0.0651*CA (Menke and Steingass 1988) (n=385, r^2=0.92)
ME, MJ/kg DM= 0.157GO+0.0084CP+0.022CF-0.0081CA+1.06 (Menke and Steingass 1987) (n=200, r^2=0.94)
NEL, MJ/kg DM= 0.115*GP+0.0054*CP+0.0014EE-0.0054*CA-0.36 (Menke and Steingass 1987) (n=200, r^2=0.93)

GP, DOM, ME, and NEL ingredients of raw materials used in this research are given in Table 2. The followings are determined for pasta, pudding, vegetable soup, yoghurt soup, wafer meal, and ice cream-bran mixture; DOM as 90.99, 71.39, 91.83, 70.37, 72.61, 89.89%, ME; 12.31, 9.68, 11.61, 9.15, 15.09, 7.8 MJ/kg DM and NEL values as 6.68, 5.82 6.51, 4.91, 8.73, 4.01 MJ/kg DM respectively. DOM values of pasta, vegetable soup and ice cream-bran mixture were statistically higher (P<0.05) in comparison to pudding, yoghurt soup and wafer meal. The highest values in terms of ME and NEL were determined in wafer flour with 15.09 and 8.73 MJ/kg DM, whereas the lowest values were found out to be 7.80 and 4.01 MJ/kg DM in ice cream-bran mixture.

Graphics about GP values recorded at the 3rd, 6th, 9th, 12th, 24th, 48th, 72th and 96th hours are given in Figure 1.

Table 3. GP amounts (ml/200 mg DM) in the incubation period

Sample	3h	6h	9h	12h	24h	48h	72h	96h
Pasta	1.72 ±0.38^{b}	15.48±1.52^{bc}	34.25 ±1.27^{a}	41.15 ±1.92^{a}	53.69 ±0.86^{a}	62.30 ±0.70^{a}	66.09 ±0.92^{a}	67.46 ±0.76^{a}
Pudding	0.99 ±0.28^{bc}	22.57 ±4.03^{b}	28.68 ±2.18^{ab}	33.61 ±4.38^{ab}	45.63 ±7.63^{ab}	53.38 ±6.32^{ab}	57.67 ±6.80^{ab}	59.32 ±7.45^{ab}
Vegetable Soup	0.52± 0.00^{c}	12.79 ±1.37^{c}	25.33 ±2.00^{b}	28.20 ±2.15^{b}	40.99 ±2.63^{b}	45.69 ±2.93^{bc}	48.83 ±2.94^{bc}	51.44 ±2.64^{bc}
Yoghurt Soup	3.29± 0.17^{a}	13.00 ±1.31^{c}	23.92 ±1.68^{b}	29.12 ±1.38^{b}	35.88 ±0.79^{bc}	40.73 ±0.86^{c}	43.16 ±1.03^{c}	43.85 ±0.86^{c}
Wafer meal	1.11± 0.24^{bc}	13.85 ±3.64^{c}	22.33 ±3.28^{bc}	25.84 ±3.88^{bc}	42.80 ±2.58^{ab}	47.78 ±1.76^{bc}	49.44 ±1.57^{bc}	50.36 ±1.72^{bc}
Ice-cream bran-mix.	1.42 ±0.56^{bc}	11.75 ±1.22^{c}	16.01 ±2.12^{c}	17.85 ±2.03^{c}	25.76 ±1.53^{c}	29.16 ±1.54^{d}	31.84 ±1.51^{d}	32.98 ±1.63^{d}

*Means with different letters in the same columns are statically significant (P<0.05).

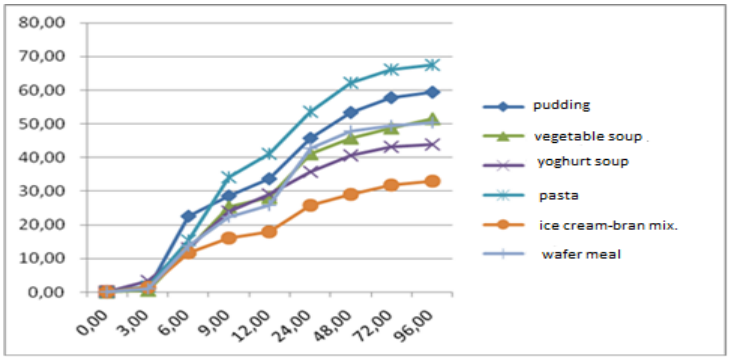

Figure 1. GP amounts in the incubation period

As seen in Table 3, GP amounts at the 3rd and 6th hours of pasta, pudding, vegetable soup, yoghurt soup, wafer meal and ice cream-bran mixture are determined to be 1.72-15.48, 0.99-22.57, 0.52-12.79, 3.29-13.00, 1.11-13.85 and 1.42-11.75 ml/200 mg DM respectively. It is remarkable that the increase in the GP amount at the 3rd and 6th hours in all samples is more than in the other hours. GP amounts of pasta, pudding, vegetable soup, yoghurt soup, wafer meal and ice cream-bran mixture at the 24th hour of incubation are 53.69, 45.63, 40.99, 35.88, 42.80 and 25.76 ml/200mg DM respectively. While the difference among ice cream-bran mixture, vegetable soup and past are found out to be statistically significant (P<0.05), the difference between ice cream-bran mixture

and yoghurt soup, as well as between wafer meal and pudding are determined to be insignificant (P>0.05). The difference between the GPs of ice cream-bran mixture, yoghurt soup and pasta at the 96th of incubation (Figure 1) was found to be statistically significant (P<0.05).

Discussion

In the study carried out, when crude nutrient ingredients of pasta, pudding, vegetable soup, yoghurt soup, wafer meal and cream-bran mixture mixture are analysed, it was seen that there were changes in CP 3.43-15.84%, EE 4.38-33.03%, CA 0.94-28.16% in DM. There were no studies found related to nutrient ingredients of the above mentioned feedstuff. Due to these materials being searched whether to be able to be used in ruminant feeding as a substitute for fodder rich in energy, it is suggested that they could be compared with the nutrient ingredients of barley, wheat, oat, maize and wheat bran. In a study carried out by Abaş et al. (2005), it is stated that in DM of barley, wheat, oat, maize and wheat bran, there were changes such as CP ingredients 9.26-18.42%, EE ingredients 1.72-5.6%, CA ingredients 1.74-9.12%. CP ingredients in DM of pudding and wafer meal were found out to be lower, EE ingredients of vegetable soup and wafer meal to be higher, and NFE ingredients to be similar when compared to those of materials in Abaş et al. (2005). CA being determined to be high in vegetable soup and yoghurt soup can be explained with salt and mineral content as calcium, magnesium etc. found in these soups. The more water amount increases in raw materials the more problems occur during storage. Therefore it is more desirable to have water ingredients below 10% (Ergül, 2002). High DM ingredients (98.69-87.15%) of products used in this research are not at problem causing level.

When net GP amounts in this study are evaluated, the highest GP amount was found out to be 53.69 ml in pasta, and the lowest amount was determined as 25.76 ml/ 200 mg DM in ice cream-bran mixture. It was reported that there are a close relationship between gas production and the amount of broken starch (r^2=0.998; Menke and Steingass, 1988). Starch provides a practical and lower-cost a way to conserve energy in ruminant rations, especially in cereals and corn silages. Rumen starch digestion rate and degree, volatile fatty acid (VFA) composition, effect of rumen pH and intestinal transit of indigestible starch (Mills et al 1999). In this study, the highest starch amount was determined in pasta (64.54%) and the lowest amount was determined as 4.4% in pudding (Table 1). Soycan-Önenç (2008) determined in her study that GP in the most used feed dry meadow (DMD) and cottonseed meal (COM), and barley were 39.28, 42.34 and 69.85 ml/ 200 mg DM. However, Beşkaya Gül (2003) determined that in the end of 24 our incubation, GP amounts of DMD, COM and barley were determined to change as 18.40-28.70, 34.30-45.97, 59.06-90.35 ml/200 mg DM. In another study conducted by Abaş et al. (2005) in the 24 hour incubation, the GP amounts of barley, wheat, oat, maize, and wheat bran have changed as 50.00-72.18, 48.65-75.17, 52.58-68.42, 54.77-77.69 and 32.54-56.59 ml/200 mg DM.

In this study, determined GP amount in pasta and pudding in 24 hours were higher than those determined by Soycan-Önenç (2008) for DMD and COM and lower than those determined for barley. GP in pasta were found out to be higher than those reported by Beşkaya Gül (2003) for COM, similar to those determined for DMD, and lower than those determined for barley. The obtained results are used for the calculation of the digestibility of organic matter and the NEL of feedstuff. When DOM, ME and NEL ingredients with the help of net GP amounts are evaluated, it was determined that amounts except DOM for pasta were %96.00, 13.84 MJ/kg DM and 7.96 MJ/kg DM respectively, were within the values given by Akbaş et al. (2005) for wheat (DOM=64.25-90.97, ME=9.89-14.10 MJ/kg DM, NEL=5.99-9.06 MJ/kg DM). In the conducted study, the lowest GP amount in the 24th hour was determined in ice cream-bran mixture. It was found out that GP amounts were lower, but DOM, ME and NEL ingredients revealed a similarity with the findings of Abaş et al. (2005). In addition, DOM values were found out to be similar with DOM values determined by Umucalılar et al. (2002). When data obtained for pasta are considered, it was determined that pasta could be used as an alternative to wheat in ruminant rations. Denek et al. (2004) determined that *in vitro* NEL and ME values of maize, barley, wheat, rye, oat and triticale were 8.41, 12.90 MJ/kg DM; 8.11, 12.51 MJ/kg DM; 8.23, 12.68 MJ/kg DM;8.30, 12.68 MJ/kg DM; 6.79, 9.90 MJ/kg DM and 8.43, 13.04 MJ/kg DM respectively. Graminae are an important energy source in ruminant rations (Umucalılar, 2002). Digestibility of barley starch in the rumen is approximately 80-90%, while the value in sorghum and maize is 55-70% (Nocek and Tamminga, 1991). DOM of pasta, pudding, vegetable soup, yoghurt soup, wafer flour and cream-bran mixture in this study being determined as 70.37-90.99%, supports the idea that these foods could be used as an alternative to wheat and barley in ruminant rations. It is determined that ME ingredients in this study are similar to the findings of Denek et al. (2004) and Abaş et al. (2005), NEL ingredients lower than the findings of Denek et al. (2004), but similar to those of Abaş et al. (2005).

Conclusion

Barley, wheat, maize and wheat bran being rich in energy, are widely used in ruminant rations. When data found out in the end of this study are considered was concluded that pasta, pudding, vegetable and yoghurt soups, wafer flour and ice cream-bran mixture can be used as an alternative to the above mentioned materials.

Acknowledgement

This study was taken from the MSc thesis of Firdevs KORKMAZ and was supported by NKÜBAP.00.24.YL.13.18 numbered project.

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