Black Sea Journal of Agriculture
Open Access Journal
e-ISSN: 2618 - 6578

BS Publishers

Research Article
Volume 1 Issue 1: 11-14 / January 2018
(Sayı 1 Cilt 1: 11-14 / Ocak 2018)

DETERMINATION OF NUTRIENT VALUES IN DRYING CITRUS PULP WITH ALTERNATIVE DRYING METHODS

Gökhan FİLİK[1]*, Hasan Rüştü KUTLU[2]

[1]*Department of Agricultural Biotechnology, Faculty of Agriculture, Ahi Evran University, 40100, Kırşehir, Turkey*

[2]*Department of Animal Science, Faculty of Agriculture, Çukurova University, 01330, Adana, Turkey*

Submission: *December 08, 2017;* ***Published:*** *January 01, 2018*
(Gönderi: *08 Aralık 2017****; Yayınlanma:*** *01 Ocak 2018)*

Abstract

The present study was conducted to develop a drying technology for citrus (orange, lemon and grapefruit) pulps by using scrubber heat source and determination of nutrient values in dried citrus pulps. Scrubber heat source of a calcite production plant was equipped for a drying system which by provided a dried pulp production. Firstly, water content of pulps was reduced to approximately 12% by mechanical press centrifugation. The pulps were then transferred to the vibrio-fluidizer fluid bed. After than pre-dried pulps transferred to rotary drum dryer for three hours and total water content of the pulps was reduced to approximately 8%. Chemical values of powder dried orange, lemon and grapefruit pulps such as DM in the air (926.70, 885.30 and 774.00 g/kg), CP (31.50, 65.70 and 77.00 g/kg), CF (28.50, 12.30 and 14.60 g/kg), EE (204.40, 60.40 and 65.90 g/kg), ME Mcal/kg DM (1.584, 2.492 and 2.356), pH (6.94, 6.96 and 6.93) and percentage of digestibility (61.32, 47.85 and 61.44%) were determined. In conclude, citrus pulps could be used as re-cycled industrial feed in animal nutrition by drying with scrubber heat source dryer.

Keywords: Citrus pulp, Nutrient value, Industrial waste, Drying technology

***Corresponding author:** Ahi Evran University, Agriculture Faculty, Agricultural Biotechnology Department, 40100, Kırşehir, Turkey
Email: gfilik@ahievran.edu.tr (G.FİLİK)

1. Introduction

Quality forage resources as grasslands, fruit juice industry with a cultivated forage crops pulp residues are of great importance for Turkey. The share of the total arable area of livestock feed crops sowing areas of advanced countries is 10%, but, it is, unfortunately, just 3.5% in Turkey. Rich pulp in terms of a significant amount of the water released as waste material in Turkey cannot be assessed at the desired level for ruminant animals. Thus, for making it harmless while they are causing environmental pollution and preventing global warming raided, it has been tried or removed with additional costs. Citrus pulps have three very important advantages by animal feed; i) primarily to prevent the animals being common to the food of the people, ii) contributing to the production of high quality forage needed in industry and iii) the factors that could make environmental pollution are more effective to prevent

damage to the environment by providing the opportunity to use. Regionally produced and exposed in the processing of industrial waste processed fruit and vegetables has great importance as a feed ingredient. In Turkey, in 2010, the amount of oranges, grapefruit and lemons which are processed for producing juice is approximately 94 thousand tons. Approximately 70% of the total citrus is produced in the Cukurova region in Turkey. 95% of grapefruit, lemons 85%, oranges 65%, while 75% still mandarins are grown in this region. According to MEYED (2008) Antalya is the second with its 20% of citrus production and Izmir is the last in the list. Also, 20% of the mandarins is produced in Izmir, in Turkey. Citrus fruits (orange, lemon and grapefruit) pulp materials which are exposed to large amounts in Cukurova region are considered as a model in the present study. Waste exposed as citrus pulp is aimed to make them harmless to the environment by using the appropriate and effective technologies. Thus, the pulp will be removed and the waste will be turned to a by-product, and then it will be dried and processed and it is aimed to determine the possibilities to use as a quality feed source for animal feed.

2. Materials and Methods

Citrus (oranges, lemons and grapefruit) pulps were obtained from fruit juice factories located in Cukurova Region, Turkey. The 3D image of drying system is presented in Figure 1.

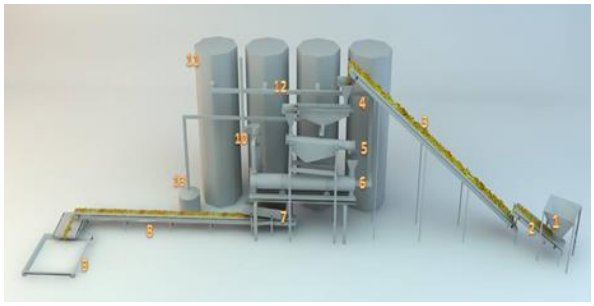

Figure 1. The 3D image of drying system

Wet citrus pulp dump trucks when brought on site first of all with accepting bunker (part 1) emptied were moved to the drying system with elevators (parts 2 and 3). Elevators transported wet citrus pulp dewatering takes place to the first pre-dewatering process (part 4) was pressed continuously mechanically screw system. The water content of the pre-dewatering wet pulp after heat treatment was removed until reduced to below 12%. After pressing the water was stored in drain line (part 13) and first pre-dewatering pulp samples was transferred to vibrating fluid bed (part 5) for the second pre-drying. Following, the second pre-drying samples was transferred to advancing rotary drum dryer module for the last drying (part 6). The dried pulps were transferred to eliminate (part 7) module. Belt drying in the module (part 8) was then decreased gradually as hot air sample collection hopper was transferred to storage tanks (part 9). The cyclone (part 10) on the system rotor removal of the cold portion of the hot air in the drying module has recognized the process. The system's main energy source, the top of the oven (part 11) tubes carrying hot air collected from the area (part 12) has been transferred to the system. The liquid released during the dewatering process (part 13) was stored in the warehouse.

Dried citrus pulps were exposed to vacuum drier system for determination of in air dry matter. Crude ash, crude fat, crude protein, crude fiber and nitrogen free extract content were determined according to AOAC (1998). NDF and ADF levels were detected in 200 Ankom Fiber Analyzer according to Van Soest et al. (1991). Organic matter digestibility (OMD) values of dried citrus pulps were determined by using Hohenheim gas production system after the end of 96 hours incubation. Metabolic energy (ME) was determined according to MAFF (1984). The percentage of Ca, Fe, K, Mg, Na and P were determined by using ICP (Perkin Elmer® Optima ™ 7000 DV ICP). The pH values of dried citrus pulps in rumen fluid were determined using the liquid pH meter (Sartorius portable pH meter PT-10). The color and texture properties of the dried pulps were determined by using Hunterlab Colorflex EZ and Stable Micro Systems TA.XT Plus Texture Analyzer, respectively.

The data on in vitro nutrient digestibility of citrus pulps in randomized plots were analyzed in the GLM procedure in SAS (1996) software. Comparison of average values was ranked by Duncan Multiple Comparison test. The results were computed as the and statistical significances were determined at the level of $P<0.05$.

3. Results

Drying modules were evaluated separately and again made the three dryer modules could be obtained by drying the desired level with individual performances. Therefore, the system was redesigned to include three modules and obtained drying the desired level. Water loss was realized between about 8-10% with front continuous mechanical dewatering screw compression. 75-77% removal of residual moisture in the pulp in order vibrio fluidized bed rotary drum dryer and belt dryer designed and tested. Citrus pulp could not be reduced to the desired moisture level systems tested as a whole one hour moving hold the as a result of moisture level of about 35 - 37% the results of the two - hour moisture level kept moving about 13 - 25%, three-hour moving orange pulp treatment results in moisture level

of 8-10% moisture level declined (Table 1).

Table 1. Determination of samples nutrient value of dried citrus pulps

Chemical Compositions	Dried Orange Pulps	Dried Lemon Pulps	Dried Grapefruit Pulps
DM in the air	926.70	885.30	774.00
Ash	109.80	76.40	60.20
Ca%	0.83	0.75	0.52
Fe%	0.12	0.03	0.03
K%	0.43	0.45	0.40
Mg%	0.06	0.05	0.04
Na%	0.02	0.01	0.01
P%	0.05	0.05	0.04
CP	31.50	65.70	77.00
EE	204.40	60.40	65.90
NPN	34.40	664.40	640.00
CF	28.50	12.30	14.60
NDF	355.20	21.90	20.20
ADF	34.00	20.00	21.60
ME Mcal/kg DM	1.584	2.492	2.356
Physical Compositions			
L*	44.85	46.12	41.89
a*	4.58	10.04	8.81
b*	22.73	28.38	25.28
a*/ b*	0.20	0.35	0.35
C*	521.20	815.50	647.90
H°	78.61	70.51	70.79
Hardness Values (Newton)	39.78	31.60	67.12
Digestibility			
OMD%	61.32	47.85	61.44
NEL (MJ/kg KM)	4.64^{c}	4.96^{b}	9.71^{a}
ME (MJ/kg KM)	8.74^{b}	7.27^{c}	9.22^{a}
pH	6.94^{b}	6.96^{a}	6.93^{b}

^{a,b,c} Means in rows with different superscripts are significantly different at $P<0.05$.

DM: dry matter, CP: Crude Protein, EE: Ether Extract, NPN: Non-Protein-Nitrogen, CF: Crude Fibre, NDF: Nötral Detergent Fibre, ADF: Acid Detergent Fibre, ME: Metabolic Energy, L*: , a*: , b*: , a*/ b*: , C*: , H°: , OMD: Organic Matter Digestibility, NEL: Net Energy Lactiation,

4. Discussion

The juice pulp was available as fresh from the factory and was dried in the laboratory with a nutrient content was determined to be reported in the literature. Orange pulp-drying for three hours at NRC (2001) nutritional substances is given for maize and fiber content was found to be richer. Also, different amounts of the citrus pulp in the following researchers have tried study as a substitute for maize and barley in rations of ruminant animals, investigated the potential to be substituted. Bhattacharya and Harbin (1973) ration instead of corn, 400 g / kg DM, Henrique et al. (7) 650 g / kg DM, Vijchulata et al. (1980) studied with two different studies, 400 and 600 g / kg DM, Lanza (1984) is a dry orange pulp and corn in half on another 250 or 500 g / kg level corn dry substitution with orange pulp on, Schalch et al. (2001) 150, 300, 450 kg / ton of dry citrus pulp level, Bueno et al. (2002) instead of corn dried citrus pulp quantities; 695 and 0 g / kg, 460 and 230 g / kg, 220 and 460 g / kg, 0 and 665 g / kg of ration use in the form of substitution does not create any problems reported.

When the nutrient content of communicative and taken into account; dried citrus pulps can be substituted by half the grains prepared in ruminant rations to animals instead of half of the grains used in the ratio be considered citrus pulp may be used. Hadjipanayiotou and Louka (1976) two different mixed feed that any in tons 820 kg of barley and 150 kg of soybean meal, the second mixed the of feed 200 kg of barley and 600 kg of dried citrus pulp and can be used to determine in the ration without creating problems of substitution as 180 kg of soybean meal. On the other hand, the grain in the ration of dried citrus pulp Leiva et al. (2000) has also been reported with some negativity can lead to full substitution on the yield and milk composition in dairy cows. Corn instead dried citrus pulp the use of milk yield and composition of the onto effects they examined two different studies of the first in the composition of the ration milk yield and its components on does not have an effect significantly, the second is the highly situated dry citrus pulp in the composition of the ration milk yield, reducing the milk fat and milk protein yield, and the former one was found to increase the level of milk urea nitrogen.

Nutrient content of orange pulp in citrus pulp dried assessed three hours for the dry matter has reached the desired level. Changes in chemical and physical characteristics that occur with three hours of dried orange pulp has been different. One and two hours a significant pH change in the dried pulp for organic matter digestibility was similar metabolic energy. 3 hours with dried orange pulp pH rises while the organic matter digestibility and metabolizable energy level has dropped significantly. These findings show that the at least 3 hours drying time needed in order to store the dried product for two hours while indicating that there should be a suitable drying time. Therefore, drying time; the level of organic matter and moisture-storability illustrates the optimization of metabolic energy requirement in digestibility value. On the other hand, in vitro digestibility results obtained in the Bampidis and Robinson (2006) have been reported compatible with the value of the dried product has reached the conclusion that such optimization is important for the feed value. The results obtained from total drying system that was specifically designed for the study of dried orange pulp

(three hours drying) are similar to the values specified in international standards. Physical analyzes in drying times and product appearance (color), indicating that there are close relations between product hardness. Results of this chemical orange pulp drying time can be understood and changed in accordance with the physical properties of the market demand; it was found that the hardness of the product increases dramatically with the drying. This situation is negative for the chewiness of the product probably will adversely affect the rate of use of the ration dry pulp; but at reasonable levels in the ration (20 - 30%), dried citrus pulp to be used, chewiness will be significantly adversely affected.

Cukurova region in large amounts of exposed citrus pulp was taken as the material model for the current project, the prevention of damage to the environment that the material waste, making suitable and harmless, using efficient technologies, evaluation of products, followed by dried processing to determine the feed value animal feed for the dissemination the use of concentrate feed aimed to become commercially important. The highest potential waste was the orange pulp, according to current drying methodology.

Acknowledgements

Given opportunities during the study, I offer my heartfelt thanks to Cukurova University Faculty of Agriculture, Department of Animal Science Department and GAP Agricultural Research Institute and the financial support that the Republic of Turkey Science, Industry and Technology, Ministry of Science and Technology Directorate General of Industry Theses Program (SAN-TEZ Projects) (Project No: 00652.STZ.2010-2) and Akay Mining Industry Foreign Trade Co. Ltd.

References

AOAC, 1998. Official Methods of Analysis. 16th Edition, AOAC International, Gaithersburg, MD.

Bampidis, V.A., Robinson, P.H. 2006. Citrus by-products as ruminant feeds: A review. Anim. Feed Sci. and Tech., 128:175-217.

Bhattacharya, A.N., Harb, M., 1973. Dried citrus pulp as a grain replacement for Awasi lambs. J. Anim. Sci. 36, 1175–1180.

Bueno, M.S., Ferrari Jr., E., Bianchini, D., Leinz, F.F., Rodrigues, C.F.C., 2002. Effect of replacing corn with dehydrated citrus pulp in diets of growing kids. Small Ruminant Res. 46, 179–185.

Hadjipanayiotou, M., Louka, A., 1976. A note on the value of dried citrus pulp and grape marc as barley replacements in calf fattening diets. Anim. Prod. 23, 129–132.

Henrique, W., Leme, P.R., Lanna, D.P.D., Coutinho-Filho, J.L.V., Peres, R.M., Justo, C.L., De Siqueira, P.A., Alleoni, G.F., 1998. Replacement of starch for pectin in diet with different concentrate levels. 1. Animal performance and carcass characteristics. Rev. Bras. Zootec. 27, 1206–1211.

Lanza, A., 1984. Dried citrus pulp in animal feeding. In: Holl´o, J. (Ed.), Proceedings of the International Symposium on Food Industries and the Environment. Budapest, Hungary. Elsevier Publishers, New York, NY, USA, pp. 189–198.

Leiva, E., Hall, M.B., Van Horn, H.H., 2000. Performance of dairy cattle fed citrus pulp or corn products as sources of neutral detergent-soluble carbohydrates. J. Dairy Sci. 83, 2866–2875.

MAFF, 1984. Energy Allowances and Feeding system for Ruminants. Ministry of Agriculturel, Fisheries and Food. Technical Bulletin 33.

MEYED, 2008. Fruit Water Production and Consumption Statistics in Turkey from 2000 to 2007 (2000'den 2007'ye Türkiye'de Meyve Suyu Üretimi ve Tüketimi İstatistikleri). 4 Mevsim Meyve Suyu Dergisi, 2: 19-23.

NRC, (National Research Council). 2001. The Nutrient Requirements of Dairy Cattle, 7th Revised Edition. National Academy of Sciences, Washington, D.C.

SAS, 1996. User's Guide: Statistics. Institute, Inc. Cary, NC, USA.

Schalch, F.J., Schalch, E., Zanetti, M.A., Brisola, M.L., 2001. Substitution of the corn grain ground by citric pulp in the early weaning of dairy calves. Rev. Bras. Zootec. 30, 280–285.

Van Soest, P.J., Robertson, J.B., Lewis, B.A., 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74, 3583–3597.

Vijchulata, P., Henry, P.R., Ammerman, C.B., Potter, S.G., Palmer, A.Z., Becker, H.N., 1980. Effect of dried citrus pulp and cage layer manure in combination with monensin on performance and tissue mineral composition in finishing steers. J. Anim. Sci. 50, 1022–1030.