PREDICTION THE NUTRITIVE VALUE OF PRICKLY PEAR PEELS AS A NATURAL UNCONVENTIONAL FEED RESOURCE FOR FEEDING RUMINANTS FROM CHEMICAL COMPOSITION AND *IN VITRO* DIGESTIBILITY USING DAISY II INCUBATOR

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SUMMARY

Prickly pear peels (PPPs) was evaluated for their chemical and nutritional composition as a natural feed resource for feeding ruminants in two experiments. Each experiment consisted of three rations. Concentrate feed mixture (CFM), berseem hay (BH), rice straw (RS) and PPPs were used for formulating the experimental rations (60% concentrate + 40% roughage). In the first experiment 25% or 50% of RS were replaced by PPPs. In the second experiment, the inclusion rates of PPPs were instead of 25% or 50% BH. Chemical composition and *in vitro* digestibility using DAISY II incubator were used for nutritive value prediction. The results indicated that PPPs had lower contents of CP (5.67%) and CF (10.63%) while; it had higher values of NFE (69.59%) and NSC (66.56%) when compared with other ingredients used. Prickly pear peels had the lowest values of NDF (13.67%); ADF (10.20%), ADL (2.49%), hemicellulose (3.47%) and lignin (0.74%) when compared with other ingredients, but had higher NDF- cell soluble (86.33%). The highest values of apparent dry matter digestibility (ADMD) and true dry matter digestibility (TDMD) were recorded with PPPs (90.22% and 91.46%), respectively when compared with other ingredients. The natural detergent fiber digestibility (NDFD) was higher than that in RS and CFM while, it is lower than that in BH. The prediction parameters of nutritive values from chemical analysis for TDN% and NEL, ME, NEM, NEG, and DE (Mcal /Lb of DM) of PPPs were significantly ($p<0.05$) higher than those of other ingredients and followed by CFM. The lowest values were recorded with BH and RS. Ration (3) in which PPPs replaced 50% of RS recorded the best values of NFE and NCF, but lowest values of ash and CF when compared with control ration and ration 25% RS with PPPs. Ration 3 had the lowest values of NDF, ADF, cellulose, hemicellulose and lignin, followed by ration (2). The highest values were recorded with control ration. The highest increase value of NDF-cell soluble (17.45%) was recorded with ration (3) while, the increase in ration (2) reached 9.21% when compared with control ration. The effect of inclusion different levels of PPPs instead of the same levels of RS showed significant (<0.05) increase of ADMD% with ration (3) followed by ration (2) while TDMD% was not significantly influenced by inclusion of PPPs. In the contrarily, the NDFD% was decreased. Ration (3) had the highest values of TDN%, DDM%, DMI%, NEL, ME, NEM, NEG, DE (Mcal /Lb. of DM) and GE (MJ/Kg DM) while control ration recorded the lowest values. The highest feed cost and price of TDN unit were recorded for the control ration. The highest decreasing price of TDN unit (9.09%) was obtained by ration (3). Inclusion of PPPs instead of BH decreased CP%, EE%, CF% and fiber fraction % of rations 5 and 6, while NFE%, NSC% and NDF-cell soluble % were increased. Concerning, DM digestibility determination, the highest value of TDMD% was obtained with ration 6 followed by ration 5. The predicted energy values were higher with ration 6 while it recorded the lowest value of GE. This ration also recorded the highest feeding values. Replacing PPPs instead of BH up to 50% decreased the price of TDN unit by about 13.33%. Information provided by our work introduce a package of two types of rations containing different levels of PPPs which could be used successfully, economically and nutritionally as a good unconventional ration for feeding ruminants in different purpose of production and could reduce waste disposal problems, further investigation on PPPs and its utilization as a raw material in feeding ruminants is needed.

Keywords: *DAISY^{II} incubator, feed intake, apparent and true digestibility, prickly pear peels, wheat bran and berseem hay.*

INTRODUCTION

Increasing animal protein production in Egypt depend upon the possibility of exploring and utilizing all possible and available resources of agriculture- co- products in animal feeding (El- Shinnawy and Eassawy, 2016). The processing of many fruits results in accumulation of large quantities of by -products. Proper utilization of these by-products could reduce waste disposal problems and serve as a potential new source of fats and protein for use in food and feed(Kamel and Kakuda, 2002).

In Egypt, the total area annually cultivated with prickly pear (PP) was about 14100 feddans producing about 28400 tons' fruits which calculated about 13420 tons of peels (Anonymous, 2008). Fruits of PP are recognized as an important source of vitamins for local people. The vegetable stems and fruits of PP are useful for a variety of purposes including food (fresh fruit, paste, Jam, salads and refreshing drinks) fodder (auxiliary, feed for cattle, sheep and goats) and medicinal (antidiabetic agent) and for industrial products such as alcohol, pectin's and oils (Lakshminarayana, 1980).

Peels and seeds are the waste products of the PP fruits processing industries. Prickly pear peels (PPPs) makes up about 50% of the whole fruit weight and is subsequently the major by- product while, seeds constitute about 10-15% of the edible pulp and are usually discarded as waste after extraction of the pulp. Stintzing *et. al.,* (2000) indicated that the oil processed from the seeds constitutes 7-15% of the whole seed weight and is characterized by high degree of instauration wherein linoleic acid is the major fatty acid (57-77.1%).

The fruits have a thick peel enclosing a delicately flavored very seedy pulp. There are few reports in literatures about the utilization of the peels of PP fruits. Badr *et. al.,* (2017) cleared that PPPs is a source of protein (4.75%), carbohydrates (59.25%), calcium (2.04%), iron (80.35mg/kg), zinc(37.49mg/kg), copper(1.92mg/kg), phosphorous (0.9%), mannan (7.76%), betaglucan (27.25%) and β- carotene (141.4µg/100g). PPPs content of hemicellulose, cellulose and lignin were 0.5, 10.92% and 1.2%, respectively. Amino acid profile ensured the existence of fifteen amino acids of which seven were essentials: leucine (0.22%), valine (.19%), lysine (0.11%), phenylalanine (0.14%), threonine (0.14%), isoleucine (0.15%) and histidine (0.09%). The remaining amino acids were aspartic acid (0.28%), arginine (0.15%), alanine (0.19%), proline (0.23%), glutamic acid (0.32%), glycine (0.18%) and serine (0.14%). So, the chemical composition indicated that PPPs is rich (on dry matter basis) in its content especially in readily digestible carbohydrate that it's may serve as a good source of fermentable ME. Although it has been used as an animal feed its value especially for farm animals, has received little research attention.

One of the major needs within the PP industry is the development of new processed PP products as well as the fruit by products. These new functional components from prickly pear peel open new possibilities for adding value to a very ancient, but not sufficiently known, crop of the arid and semi -arid regions. The expansion of the PP cultivation in arid and semi- arid areas could be of interest for stimulating bio industries in developing countries (Terrazas *et. al.* ,2002).

The purpose of this study is the evaluation of the chemical composition and feeding value of PPPs as a by–product and investigating the effects of its inclusion in ruminant rations, instead of rice straw (RS) and berseem hay (BH) from nutritional and economical points of view.

MATERIAL AND METHODS

The present study was conducted at the Laboratories of the Regional Center for Food and Feed (RCFF), Agric. Res. Center (ARC), Ministry of Agric., Giza, Egypt.

Preparation of the dried powder of PPPs and feed ingredients:

The prickly pear peels (PPPs) were collected from local market of Giza Governorate during summer season (August 2016). The peels were dried by spreading in direct sun after being chopped (about 3cm length). The peels were shuffled upside- down and mixed well every day until its moisture content regressed to about 20%. Complete drying was done by using an oven at 55^0C for 8h., the dried peels and feed ingredients were grounded in a blender for 5min. and packed in polyethylene bags until analysis.

Experiments:

Concentrate feed mixture (CFM), berseem hay (BH), rice straw (RS) and prickly pear peels (PPPs) were used in formulation the experimental rations. Two experimental rations were formulated to determine the chemical composition and estimate the feeding values of PPPs. Each experiment consisted of three rations as follows:

Experiment (1): Three complete rations (about 12% cp) were formulated for fatting animals in the first stage. In this experiment 25% and 50% of RS were replaced by PPPs as follows:

Ration (1): 60%CFM+40%RS (control ration).

Ration (2): 60% CFM+30%RS+10%PPPs.

Ration (3) 60%CFM +20%RS+20%PPPs.

Experiment (2): Three complete rations (about 17% crude protein) were used in this experiment for lactating cattle. Berseem hay was replaced with 25% and 50% by the same levels of PPPs in rations 5 and 6, respectively as follows:

Ration (4): 60%CFM+40%BH (control ration).

Ration (5): 60% CFM+30% BH+10%PPPs.

Ration (6) 60%CFM +20% BH+20%PPPs.

Representative samples of feed ingredients and experimental rations were taken for proximate analysis according to the procedures of AOAC (2002). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents of feed ingredients and experimental rations were determined according to Van Soest *et al.* (1991). Cellulose (CEL.) and hemicellulose (HEM.) contents were calculated respectively, by subtracting ADL from ADF and ADF from NDF.

In- vitro digestion with Ankom Daisy ^{II} incubator method: In vitro digestibility's of feed ingredients and experimental rations were done by using the Ankom Daisy^{II} incubator procedure. The procedure followed is described in detail by Goeser and Combs (2009). Tilley and Terry technique (1963) was used for the determination of apparent dry matter digestibility (ADMD). True in vitro DM digestibility (TDD) can be determined by measuring the neutral detergent fiber (NDF) in the residue from the incubation with rumen inoculum and buffer. Neutral detergent fiber digestibility (NDFD) was determined with Ankom Daisy^{II} incubator procedure. *In -Vitro* true digestibility and NDFD were calculated according to Ankom daisy^{II} incubator method:

Prediction of energy estimation by equations for feed evaluation using chemical components of feed:

Prediction of energy availability from laboratory analyses usually requires specific equations for each type of feed. The accuracy of energy predictions is a function of the accuracy of laboratory analyses and the accuracy of the animal experimentation used to develop the prediction equation Available energy and digestibility cannot be measured in the laboratory and is estimated from chemical composition. Most energy values are predicted from fiber analyses because fiber is negatively related to the animal's ability to digest and use nutrients in the feed according to **NRC, (2001).**

Equations:

GE= Growth Energy (MJ/Kg DM) =0.0226*CP+0.0407*EE+0.0192*CF+0.0177*NFC according to Maff (1975)

DDM= Dry Matter Digestibility%= 88.9- (0.779*ADF%).

DMI= Dry Matter Intake = 120/ NDF%.

DE= Digestible Energy (Mcal /Lb. of DM) = (0.04409*TDN)/2.204.

TDN= Total Digestible Nutrients (100%DM) = 82.38-(0.7515*%ADF).

ME= Metabolizable Energy (Mcal /Lb. of DM) = (1.01*(0.04409*TDN))-0.45)/2.204.

NEM= Net Energy Maintenance (Mcal/Lb. of DM) = (1.37*ME) -(0.138*ME^2) -(0.105*ME^3)-1.12/2.204.

NEG= Net Energy Growth (Mcal/Lb. of DM) = (1.42*ME) -(0.174*ME^2) -(0.0122*ME^3)-1.65)/2.204.

NEL= Net Energy of Lactation (Mcal /Lb. of DM) = ((0.0245*TDN)-0.12)/2.204).
NSC= Non- Structure Carbohydrate =100- (NDF%+CP%+EE%+ASH%).

Economic study:

According to market prices of different feed ingredients used for formulating rations, the feed cost and the price of TDN unit of each experimental ration was calculated. The prices of feed ingredients in Egyptian pound (LE / ton) were 4000 concentrate feed mixture (CFM), 1800 berseem hay (BH), 600 rice straw (RS) and 200 PPPs according to price (2017).

Statistical analysis:

Data were analyzed according to the statistical analysis system user guide, (SAS 1998). Separating among means was carried out by using Duncan multiple test (1955).

RESULTS AND DISCUSION

The chemical compositions of feed ingredients:

Chemical compositions of feed ingredients used for formulating the experimental rations are presented in Table (1). The results showed that chemical composition of berseem hay and CFM were within the corresponding ranges reported by El-Shinnawy et. al., (2011 a and b). The data for chemical composition of PPPs were in agreement with those obtained by (Gregory and Felker, 1992, Felker, 1995; Lopez et. al., 2001; El-Said et al., 2011 and Badr et al., 2017). It is interest to note that PPPs had lower contents of CP (5.67%)and CF (10-69%) while, it had higher values of NFE (69.59%) and NSC (66.56%) when compared with other ingredients used. Comparable values of CP content have been reported for PPPs grown on poor soils (De Kock, 1980; Flachowsky and Yami, 1985; and Hanselka and Paschal, 1990). Data of fiber fraction values are shown in Table (1). The results indicated that PPPs had the lowest values of NDF (13.67%); ADF (10-20%); ADL (2.49%); hemi. (3.47%), cell (7.71%) and lignin (0.74%)when compared with another ingredient but higher nonstructural carbohydrate, NDF-cell soluble (86.33%). In the contrary of PPPs, RS contained higher NDF, ADF and ADL, cellulose, hemicelluloses and lignin when compared with other ingredients. The NDF content of PPPs obtained in this study is higher than that recorded by Amare *et al.* (2009) while, the ADF content is lower. In- vitro Daisy^{II} incubator analysis of appeared dry matter digestibility (ADMD) and True dry matter digestibility TDMD) are shown in Table (2). The results indicated that the highest values of ADMD and TDMD were recorded with PPPs (90.22% and 91.46%), respectively when compared with other ingredients. The neutral detergent fiber digestibility (NDFD) was higher than that in rice straw and concentrate mixture while, it is lower than that in berseem hay. Predicting the energy values of ingredients based on chemical composition are illustrated in Table (2). The results indicated that the prediction values of DDM 80.95%., DMI 8.78% and TDN 74.72% of PPPs where significantly ($p<0.05$) higher than that of others, followed by concentrate mixture. The lowest values were recorded with berseem hay and rice straw. The prediction parameters from chemical analysis for %TDN, ME, NEM, NEG and DE (Mcal/Lb of dry matter in Table (2) followed the same trend. The significant ($p<0.01$) highest values were recorded with PPPs followed by concentrate mixture and berseem hay but the lowest values were in rice straw.

Experimental (1): Inclusion two levels of PPPs instead of the same levels of RS in ruminant rations:

Table (3) presented the chemical compositions and fiber fractions of the three experimental rations. The results indicated that ration 3 which contained 20% PPPs recorded the higher values of NFE and NCF, but lower values of ash and CF when compared with the other experimental rations. The obtained results are in agreement with those recorded by Ben Salem *et. al.*, (1996) and Mengistu (2001) who reported that PPPs is rich in readily available carbohydrates which could serve as a source of energy for animals. There are no noticeable differences in OM, CP and EE among the three rations. The results of CP content were in accordance with that obtained by Felker., (1995) The similarity of CP content in the three rations may be attributed to the similar CP content of RS and PPP,s

Results presented in Table (3) show that replacement 25% of RS with PPPs (ration 2) decreased NDF, ADF, cellulose, hemi and lignin when compared with ration 1 (control ration). The highest values of decrease were recorded with ration 3 (containing 20% PPPs) when compared with control ration or ration 2. The highest increase value of NDF- cell soluble (14.86%) was recorded with ration (3) while increase in NDF, cell soluble in ration 2 reached 8.43% when compared with control ration.The low fiber content in ration 2 and 3 which containing PPPs were in comparable with those obtained by **Tikabo *et al.* (2006)**. Data in Table (4) indicated significant (p<0.01) increase of ADMD% with ration 3 followed by ration 2 but, the lowest value was recorded with control ration. The TDMD% was not significantly influenced by inclusion of PPPs while, NDFD% was decreased with ration 3 when compared with other rations.

Predictions of energy by equations for rations of experiment (1) are presented in Table (4). The results indicated that ration 3 had higher values of TDN%, NEL, ME, NEG, DE, DDM, DMI and GE% than that of other rations. Control ration recorded the lowest values while, the values of ration (2) were intermediate. The feed cost and price of TDN unit of each experimental ration are presented in Table (5). The results indicated that the highest cost of TDN units was recorded for the control ration (60% CFM +40% RS), while the lowest cost was observed with ration 3 (60%CFM+20%RS+20%PPPs). The highest % of decreasing price of TDN units (9.09%) was recorded for ration 3.

Experiment (2): Inclusion two of PPPs instead of the same levels of BH. in ruminant rations.

The effect of inclusion of PPPs instead of BH on chemical composition and fiber fraction in experiment (2) are presented in Table (6).

Replaces BH by PPP,s in basal ration by 0, 10 and 20% on dry matter basis decreased CP, EE, CF and fiber fraction of rations 5 and 6 while BH and PPP,s increased NFE%, NSC% and NDF-cell soluble. The highest values were recorded with ration 6 while the lowest values were obtained with control ration. Data in Table (7) indicated the results of DM digestibility determination by *In-Vitro* Daisy^{II}incubator. The highest value of TDMD% was obtained with ration 6, followed with ration 5. There were no significant differences among the three rations concerning ADMD% and NDFD%.

Predicted energy of rations used in experiment (2) from chemical composition is indicated on Table (7). The predicted energy values of ration (6) were 0.72, 1.19, 0.76, 2.19 and 1.39 (Mcal/ Lb DM) for NEL, ME, NEM, NEG and DE, respectively. These values are higher than those obtained by ration (5) and control. The lowest value of GE was recorded for ration 6. Table (7) showed the predicted feeding values of rations used in experiment 2. Ration 6 recorded the highest values of TDN, DDM and DMI%. Concerning DMI, the present results are in good agreement with those of **Azocar and Rojo (1991)** who found that inclusion PPPs in rations increased DMI%.

From the economical point of view (Table 8) the lowest price of TDN unit was recorded with ration 6 followed by ration 5. The decreasing (Table 8) percent in the price of TDN unit reached 13-33% with ration 6 than that of control. This experiment cleared that replacing PPPs instead of BH up to 50% decreased the feed cost by about 11.43%. This decrease in feed cost may be due to that PPPs is a cheaper by product than berseem hay.

CONCLUSION

This investigation show the potential value of PPPs as a good natural source of energy and nutritive components. Ration 3 (60%FM+20%RS+20%PPPs.) and ration 6 (60%FM+20% BH+20%PPPs.) appear to be promising package from the nutritional and economical point of view and introduce two complete rations for different purposes of productions for dry season feeding systems that could enhance productivity of livestock. The results are also important for industrial utilization of the major by – product of the fruit. However, further chemical and nutritional evaluations are needed and more work is required for the application of PPPs in *In -vivo* trials for feeding ruminants.

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التنبؤ بالقيمة الغذائية لقشور التين الشوكى كمصدر غذائى طبيعى غير تقليدى لتغذية المجترات من المكونات الغذائية والهضم المعملى باستخدام تقنيه DAISY^{II} INCUBATOR

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تم تقييم التركيب الكيماوى والمكونات الغذائية للتين الشوكى كمصدر طبيعى لتغذية المجترات فى تجربتيين . تتكون كل تجربة من ثلاثة علائق. إستخدام مخلوط العلف المركز ؛ دريس البرسيم ؛؛ قش الأرز وقشور التين الشوكى فى تكوين العلائق التجريبية (٦٠% مركز + ٤٠% مواد خشنة). التجربة الأولى تم إستبدال ٢٥ أو ٥٠% من قش الأرز بقشور التين الشوكى . وفى التجربة الثانية تم إحلال قشر التين الشوكى بدلا من ٢٥ او ٥٠% من دريس البرسيم. ولقد استخدمت المكونات الغذائية والهضم المعملى باستخدام تقنيه INCUBATOR DAISY^{II} فى التقديرات .

ولقد أظهرت النتائج أن قشور التين الشوكى ذات محتوى منخفض من البروتين الخام (٥.٦٧ %) والألياف الخام (١٠.٦٣%) بينما تحتوى على قيم مرتفعة من مستخلص خالى الأزوت (٦٩.٥٩%) و الكربوهيدرات غير الذائبة (٦٦.٥٦%) عند مقارنتها بالمواد العلفية الأخرى المستخدمة. وتحتوى قشور التين الشوكى على قيم منخفضة من الألياف المتعادلة (١٣.٦٧%) ، الألياف الحامضية (١٠.٢٠%)، اللجنيين الحامضى (٢.٤٩%) ، الهيمسليلوز (٣.٤٧%) واللجنيين (٠.٧٤%) عند مقارنتها بالمصادر الغذائية الأخرى ، ولكنها تحتوى على قيم مرتفعة من الألياف المتعادلة – الخلايا الذائبة (٨٦.٣٣%). والقيم الغذائية المرتفعة للمهضوم الظاهرى من المادة الجافة والمهضوم الحقيقى من المادة الجافة كانت (٩٠.٢٢ و ٩١.٤٦%) على التوالى عند مقارنتها أيضا بالمواد الغذائية المستخدمة . ولقد كان المهضوم من الألياف المتعادلة فى قشور التين الشوكى أعلى من قش الأرز ومخلوط العلف المركز بينما كان منخفضاً عما فى الدريس. وكان المتنبأ للقيم الغذائية من التحليل الكيماوى للمركبات الكلية المهضومة % والطاقة الصافية لإنتاج اللبن ، الطاقة الممثلة ، الطاقة الصافية للعليقة الحافظة ، الطاقة الصافية للنمو والطاقة المهضومة (ميجا كالورى / رطل مادة جافة) لقشور التين الشوكى مرتفعا معنوياً عن قيم المواد الغذائية الأخرى وكان يليها مخلوط العلف المركز بينما أقل القيم كانت لدريس البرسيم وقش الأرز .ولقد سجلت العليقة الثالثة التى تم إحلال ٥٠% من قشور التين الشوكى محل ٥٠% من قش الأرز أحسن قيم لمستخلص خالى الأزوت والمواد غير الكربوهيدراتية ولكن أقل القيم كانت للرماد و الألياف الخام عند مقارنتها بعليقة المقارنة أو العليقة الثانية . حققت العليقة الثالثة أقل قيم فى الألياف المتعادلة ، الألياف الحامضية ، السليلوز ، الهيمسليلوز واللجنيين يليها العليقة الثانية بينما كانت أعلى القيم مع عليقة المقارنة . وبلغت نسبة الزيادة المئوية للعليقة الثالثة عن عليقة المقارنة فى الألياف المتعادلة – للخلايا الذائبة ١٧.٤٥% بينما كانت تلك النسبة ٩.٢١% مع العليقة الثانية . وتضمين العليقة مستويات مختلفة من قشور التين الشوكى بدلا من قش الأرز أظهر زيادة معنوية فى المادة الجافة المهضومة ظاهريا من المادة الجافة مع العليقة الثالثة يليها العليقة الثانية بينما لم يتأثر المهضوم الحقيقى من المادة الجافة بتضمين العليقة بقشور التين الشوكى وعلى العكس إنخفض المهضوم من الألياف المتعادلة . ولقد حققت العليقة الثالثة أعلى قيم من المركبات المهضومة ، الطاقة الصافية للبن ، الطاقة التمثيلية ، الطاقة الصافية للعليقة الحافظة ، الطاقة الصافية للنمو ، الطاقة المهضومة ، المهضوم من المادة الجافة ، المادة الجافة المأكولة والطاقة الكلية بينما سجلت عليقة المقارنة قيما منخفضة . كما سجلت عليقة المقارنة أعلى سعر لوحدة الطاقة الكلية المهضومة . بينما سجلت العليقة الثالثة أعلى إنخفاض فى سعر وحدة الطاقة الكلية المهضومة (٩.٠٩%). أدى تضمين العلائق بقشور التين الشوكى بدلا من دريس البرسيم إلى إنخفاض قيم البروتين الخام ، الدهن الخام ، الألياف الخام ومشتقات الألياف فى العلائق الخامسة والسادسة بينما إرتفعت قيم الكربوهيدرات الذائبة ، نسبة المركبات غير الكربوهيدراتية والألياف المتعادلة – الخلايا الذائبة . وبخصوص تقديرات المهضوم من المادة الجافة ، حققت العليقة السادسة أعلى قيم من المهضوم الحقيقى للمادة الجافة تليها العليقة الخامسة . وبالنسبة للقيم المتنبأ بها من الطاقة فقد حققت العليقة السادسة أعلى القيم بينما سجلت تلك العليقة أقل قيمة للطاقة الكلية وكذلك سجلت قيماً غذائية مرتفعة . أدى إحلال قشور التين الشوكى محل الدريس حتى ٥٠% إلى تخفيض سعر وحدة الطاقة الكلية المهضومة بنسبة ١٣.٣٣ % مقارنة بعليقة المقارنة . والمعلومات التى إستفيناها من هذه الدراسة تقدم باقه من نموذجين من الأعلاف التى تحتوى على نسب مختلفة من قشور التين الشوكى التى يمكن أن تستخدم بنجاح، إقتصاديا وتغذوياً كعليقة غير تقليدية فى تغذية المجترات للأغراض الإنتاجية المختلفة كما تؤدى إلى تقليص التلوث البيئى وتفتح الدراسة مجالاً الى المزيد من البحث للوصول إلى الإستخدام الأمثل لقشور التين الشوكى كمادة علفية خام فى تغذية المجترات.

Table (1): Chemical composition and fiber fraction of feed ingredients used for formulating the experimental rations.

Ingredient	concentrate feed mixture (CMF)|*	Rice straw (RS)	Berseem hay (BH)	prickly pear peels (PPPs)	SE±
Dry matter (DM)%	94.34	94.71	94.44	92.21	
Composition on dry matter, %					
Organic matter (OM)	93.24	80.99	88.15	89.37	
Crude ash	6.76	19.01	11.85	10.63	
Crude Protein (CP)	16.91	5.42	18.81	5.67	
Ether extract (EE)	4.23	1.19	2.27	3.47	
Crude fiber (CF)	13	32.38	29.42	10.64	
Nitrogen free extract (NFE)	59.1	42	37.65	69.59	
Non-structure carbohydrate (NSC)	40.98	6	31.38	66.56	
Fiber fraction analysis, %					
NDF	31.12c	68.38a	35.69b	13.67d	0.26
ADF	15.25c	49.84a	30.22b	10.2d	0.16
ADL	5.66c	10.7a	6.83b	2.49d	0.09
AIA	0.623c	1.51b	1.547b	1.75a	0.01
Hemicelluloses	15.8b	18.56a	5.47c	3.47d	0.14
Cellulose	9.59c	39.14a	32.39b	7.71d	0.12
Lignin	3.5c	8.01a	5.4b	0.74d	0.1
NDF-cell soluble	68.88b	31.62d	64.31c	86.33a	0.26

a, b, c and d means within the same raw with different superscripts are significantly different at ($p<0.05$)
** CFM consists of 35% uncorrected cotton seed meal, 30% wheat brain, 22% yellow corn, 7% rice brain, 3% molasses, 2% lime-stone and 1% common salt.*

Table (2): Dry matter digestibility using *In-Vitro* Daisy^{II} incubator and predicting energy and feeding values of ingredients based on chemical analysis.

Ingredient	Rice straw (RS)	concentrate feed mixture (CMF)|*	Berseem hay (BH)	prickly pear peels (PPPs)	SE±
In -vitro daisy analysis:					
$ADMD_{IV}$ %	45.43_c	60.25_b	59.52_b	90.22_a	0.57
$TDMD_{IV}$ %	65.12_c	79.68_b	80.41_b	91.46_a	0.46
$NDFD_{IV}$ %	70.39_{bc}	67.75_c	75.59_a	72.23_{ab}	1.02
Predicted energy:					
NEL (Mcal/ Lb. of DM)	1.05_d	1.68_b	1.41_c	1.78_a	0.02
ME (Mcal/ Lb. of DM)	0.70_d	1.23_b	1.00_c	1.31_a	0.02
NEM (Mcal/ Lb. of DM)	0.35_d	0.77_b	0.62_c	0.82_a	0.00
NEG (Mcal/ Lb. of DM)	0.16_d	0.71_b	0.49_c	0.78_a	0.00
DE (Mcal/ Lb. of DM)	0.90_d	1.42_b	1.19_c	1.50_a	0.00
GE (MJ/Kg DM)	1.54_c	1.85_a	1.75_b	1.71_b	1.06
Predicted Feeding values%:					
TDN %	44.93_d	70.92_b	59.67_c	74.72_a	0.00885
DDM %	50.07_d	77.02_b	65.36_c	80.95_a	0.0082
DMI %	1.75_c	3.86_b	3.36_b	8.78_a	0.00

a, b, c and d means within the same raw with different superscripts are significantly different at ($p<0.05$).

Table (3): Chemical composition and fiber fraction of rations used in experiment (1) (inclusion two levels of PPPs instead of the same levels of rice straw).

Ingredients	Experimental rations			SE ±
	Ration 1	Ration 2	Ration 3	
DM%	94.49	94.16	93.99	
composition on dry matter %				
Organic matter (OM)	88.33	89.37	90.01	
Ash	11.67	10.63	9.99	
Crude Protein (CP)	12.3	12.34	12.39	
Ether extract (EE)	4.07	3.47	3.25	
Crude fiber (CF)	20.77	18.58	16.44	
Nitrogen free extract (NFE)	51.19	54.98	57.93	
Non-structure carbohydrate (NSC)	30.40	37.38	43.01	
Fiber fraction analysis%:				
NDF	41.56_a	36.18_b	31.36_c	0.22
ADF	23.52_a	20.42_b	17.81_c	0.16
ADL	4.58_a	4.31_a	4.26_a	0.26
AIA	0.86_c	1.44_b	1.61_c	0.19
Hemicelluloses	18.04_a	15.76_b	13.55_c	0.06
Cellulose	18.94_a	16.11_b	13.55_c	0.099
Lignin	3.72_a	2.87_{ab}	2.65_b	0.26
NDF-cell soluble	58.44_c	63.82_b	68.64_a	0.22

a, b, c and d means within the same raw with different superscripts are significantly different at ($p<0.05$).
Ration (1): Control 60% CFM + 40% RS.
Ration (2): 60% CFM+30% RS+10% PPPs.
Ration (3): 60% CFM+20% RS+20% PPPs.

Table (4): Dry matter digestibility determination using *In-Vitro* **Daisy^{II} incubator and predicting energy and feeding values of rations used in experiment (1) (inclusion two levels of PPPs instead of the same levels of rice straw).**

Ingredients	Experimental rations			SE ±
	Ration 1	Ration 2	Ration 3	
In -vitro daisy analysis:				
$ADMD_{IV}$ %	56.78_a	60.46_a	63.3_a	2.15
$TDMD_{IV}$ %	68.27_a	67.57_a	69.66_a	1.89
$NDFD_{IV}$ %	61.07_a	64.43_a	56.33_a	5.02
Predicted Energy:				
NEL (Mcal/ Lb. of DM)	0.665_c	0.69_b	0.71_a	0.002
ME (Mcal/ Lb. of DM)	1.10_c	1.15_b	1.19_a	0.0033
NEM (Mcal/ Lb. of DM)	0.70_b	0.73_a	0.73_a	0
NEG (Mcal/ Lb. of DM)	2.10_c	2.14_b	2.18_a	0.001
DE (Mcal/ Lb. of DM)	1.29_c	1.34_b	1.38_a	0.0033
GE (MJ/Kg DM)	1.798_b	1.799_b	1.80_a	0.001
Predicted Feeding values:				
TDN %	64.71_c	67.03_b	68.996_a	0.12
DDM %	70.58_c	72.99_b	75.02_a	0.123
DMI %	2.89_c	3.32_b	3.83_a	0.027

a, b, c and d means within the same raw with different superscripts are significantly different at ($p<0.05$).
Ration (1): control 60% CFM + 40% RS.
Ration (2): 60% CFM+30% RS+10% PPPs.
Ration (3): 60% CFM+20% RS+20% PPPs

Table (5): Feed cost and prices of TDN unit of the three complete rations used for fatting animals at the first stage (about 12% CP).

Items	Experimental rations		
	Ration 1	Ration 2	Ration 3
Feed cost (P.T.)/ Kg feed	264.0	260	256
TDN, %	64.70	67.03	69.00
Price of TDN unit (P.T.)	408.00	387.90	371.00
% of decreasing price of TDN unit than that of control	__	4.39	9.09

Ration (1): Control 60% CFM +40%RS.
Ration (2): 60% CFM. +30%RS + 10%PPPs.
Ration (3): 60% CFM. +20%RS+ 20%PPPs.

Table (6): Chemical composition and fiber fraction of rations used in experiment (2) (inclusion two levels of PPPs instead of the same levels of berseem hay).

	Experimental rations			SE ±
Ingredients	Ration 4	Ration 5	Ration 6	
DM, %	94.38	94.16	93.93	
composition on dry matter, %				
Organic matter (OM)	91.20	91.33	91.46	
Ash	8.80	8.67	8.54	
Crude Protein (CP)	17.67	16.38	15.08	
Ether extract (EE)	3.89	3.79	3.68	
Crude fiber (CF)	19.57	17.71	15.08	
Nitrogen free extract (NFE)	50.07	53.45	57.62	
Non-structure carbohydrate (NSC)	36.24	41.71	43.54	
Fiber fraction analysis %:				
NDF	33.4_a	29.45_b	29.16_b	**0.197**
ADF	20.37_a	17.55_b	17.2_c	**0.058**
ADL	5.62_a	4.86_c	5.12_b	**0.086**
AIA	1.73_a	1.08_b	0.12_c	**0.0093**
Hemicelluloses	13.03_a	11.9_b	11.96_b	**0.164**
Cellulose	14.75_a	12.69_b	12.08_c	**0.124**
Lignin	3.89_b	3.78_b	5.00_a	**0.088**
NDF-cell soluble	66.60_c	70.55_b	70.84_a	**0.197**

a, b, c and d means within the same raw with different superscripts are significantly different at ($p<0.05$)
Ration (4): Control 60% CFM. +40%BH
Ration (5): 60% CFM. + 10%PPPs +30%BH.
Ration (6): 60% CFM. + 20%PPPs +20%BH.

Table (7): Dry matter digestibility determination by *In-Vitro* Daisy^{II} incubator and Predicting energy and feeding values of rations used in experiment (2) (inclusion two levels of PPPs instead of the same levels of berseem hay).

Ingredients	Experimental rations Ration 4	Ration 5	Ration 6	SE ±
In -vitro daisy analysis:				
ADMDIV %	66.38_b	66.94_a	66.15_c	1.93
TDMDIV %	68.58_c	71.82_b	82.27_a	1.93
NDFD %	61.06_a	61.83_a	61.07_a	
Predicted Energy:				
NEL (Mcal / Lb. of DM)	0.69_c	0.71_b	0.72_a	0
ME (Mcal / Lb. of DM)	1.15_c	1.19_b	1.20_a	0.0017
NEM (Mcal / Lb. of DM)	0.73_c	0.75_b	0.76_a	0.0029
NEG (Mcal / Lb. of DM)	0.64_b	2.19_a	2.19_a	0.0017
DE (Mcal / Lb. of DM)	1.34_c	1.38_b	1.39_a	0.0017
GE (MJ/Kg DM)	1.89_a	1.88_b	1.86_c	0.0017
Predicted Feeding values:				
TDN %	67.072_c	69.19_b	69.45_a	0.044
DDM %	73.03_c	75.23_b	75.50_a	0.045
DMI %	3.59_b	4.08_a	4.12_a	0.04

a, b, c and d means within the same raw with different superscripts are significantly different at ($p<0.05$)
Ration (4): Control 60% CFM. + 40%BH.
Ration (5): 60% CFM. + 10%PPPs +30%BH.
Ration (6): 60% CFM. + 20%PPPs +20%BH.

Table (8): Feed cost and prices of TDN unit of the three complete rations (4 ,5 and 6) used for feeding high producing animals and dairy cows (about 17% CP).

Items	Experimental rations Ration 4	Ration 5	Ration 6
Feed cost (P.T.)/ Kg feed	312	296	280
TDN, %	67.07	69.19	69.45
Price of TDN unit (P.T.)	465.00	428.00	403.00
% of decreasing price of TDN unit than that of control	__	7.96	13.33

Ration (4): Control 60% CFM. +40%BH
Ration (5): 60% CFM. + 10%PPPs +30%BH.
Ration (6): 60% CFM. + 20%PPPs +20%BH.