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## ***In vitro* gas production parameters of chickpea (*Cicer arietinum* L.) by-product**

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**Introduction** Chickpea (*Cicer arietinum* L.) is a legume seed, which is mostly used for human food. Approximately 7500 ton wastes of chickpea including pre-screening seeds and chickpea bran (known as chickpea by-product) are produced annually in North West Iran. The aim of the present study was to determine chemical composition and *in vitro* gas production parameters of chickpea by-product.

**Material and methods** Samples of chickpea by-product including pre-screening seeds and chickpea bran were collected from chickpea sorting factories located in North West Iran during September to December, 2008. Chemical composition including organic matter (OM), crude protein (CP), ether extract (EE) and crude fibre (CF) were determined using standard procedures (AOAC, 1995). Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined using the method of Van Soest *et al.* (1991). Total extractable phenolic compounds (TPC) and total tannin (TT) were determined using procedures of Julkunen-Titto (1985) and Makkar (1992), respectively. Three fistulated Balochi sheep (49.5±2.5 kg) were used as rumen liquor donor for gas production technique. The animals were fed 1 kg DM lucerne hay and 0.3 kg DM concentrate (165 g CP/kg of DM). Rumen fluid was collected before the morning feeding and strained through 4 layers of cheesecloth into a CO<sub>2</sub>-filled flask. *In vitro* incubation of the samples was done using calibrated glass syringes followed the procedures of Menke and Steingass (1988). Approximately 200 mg of each sample was weighed into four replicate calibrated glass syringes of 100 ml. The syringes were pre-warmed at 39 °C before the injection of 30 ml rumen fluid-buffer mixture into each syringe followed by incubation in a water bath at 39 °C. Readings of gas production were recorded at 2, 4, 8, 12, 24, 36, 48, 72, and 96 h after incubation. Cumulative gas production data were fitted to a model of  $Y = b(1 - e^{-ct})$ ; where: Y= potential of gas production at time t; b= gas produced from the soluble and insoluble fraction (ml); c= gas production constant rate (ml/h); t= incubation time (h). Data were statistically analyzed using SAS (1999) software.

**Results** Chemical composition of chickpea by-product is presented in Table 1. Results of the present study indicated the chemical composition, except OM, was significant different between the samples evaluated ( $P < 0.05$ ). Gas production parameter and calculated amount of organic matter digestibility (OMO) and metabolizable energy (ME) are presented in Table 2. The amount of b and value calculated for OMD and ME of chickpea pre-screening were significantly higher than chickpea bran ( $P < 0.01$ ). Gas production rate constant of chickpea bran was significantly higher than chickpea pre-screening ( $P < 0.01$ ).

**Table 1** Chemical composition of chickpea by-product (g/kg DM)

Chickpea by-product	OM	CP	EE	CF	NDF	ADF	TN	TPC
Chickpea pre-screening	940	279	78	72	351	96	1	3.4
Chickpea bran	927	44	87	178	323	224	6.5	7.5
s.e.d	6.2	5.4	1.4	2.4	6.6	10.1	0.55	0.75
P	>0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

**Table 2** Gas production parameters, organic matter digestibility (OMD)\* and metabolizable energy (ME)\*\* content of chickpea by-product

Item	Chickpea pre-screening	Chickpea bran	P
b (ml)	66.4±2.42	93.6±2.51	<0.01
c (ml/h)	0.056±0.0052	0.024±0.0023	<0.01
OMD (%)	59.1±0.42	42.1±1.5	<0.01
ME (MJ/kg)	8.95±0.074	6.5±0.2	<0.01

\*OMD = 0.9991 Gas + 0.0595 CP + 0.0181 CA + 9

\*\*ME = 0.157 Gas + 0.0084 CP + 0.022 EE – 0.0081 CA + 1.06

**Conclusions** Results obtained in the present study regarding the chemical composition of chickpea pre-screening confirmed the finding of Abdi and Danesh Mesgaran (2009). Values calculated for both ME and OMD of chickpea pre-screening were significantly higher than those of chickpea bran ( $P < 0.01$ ), which might be due to difference in chemical composition and volume of gas production in the first 24 h. It was concluded that the by-products evaluated in the present experiment had a potential to use as suitable feed in ruminant rations. However, future feeding trials will be proposed to evaluate the effect of this by-product in ruminant production.

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- 257 The effect of offering grass silage alone or in combination with legume:cereal wholecrop silage on methane emissions of Holstein steers  
P C Kennedy, L E Dawson, D J Kilpatrick
- 258 The effect of electromagnetic water treatment on *in vitro* methane production  
M O'Brien, P O'Kiely
- 259 Effect of legume and perennial ryegrass herbage on *in vitro* methane output using the total gas production technique  
A Navarro-Villa, M O'Brien, S Lopez, T M Boland, P O'Kiely
- 260 *In vitro* methane output of perennial ryegrass produced under four grazing management regimes and sampled throughout the growing season  
P Purcell, M O'Brien, T M Boland, M O'Donovan, P O'Kiely
- 261 The effect of sward maturity on the *in vitro* digestibility and methane production of sward components  
C J Quinlan, M B Lynch, M O'Brien, A Navarro, T M Boland
- 262 Effect of sward maturity on the dry matter intake, enteric methane emission and milk solids production of pasture grazed dairy cows  
M H Deighton, C M Wims, B M O'Loughlin, E Lewis, M O'Donovan

## FEED EVALUATIONS/TECHNIQUES

- 263 Effect of adding different levels of probiotic on *in vitro* gas production of noodle waste  
M Besharati, A Taghizadeh, A Ansari
- 264 Effect of peppermint (*Mentha piperita*) essential oil on *in vitro* gas production parameters of lucerne hay and cottonseed hulls  
E Jani, M Danesh Mesgaran, A R Vakili, A Soleimani, H Jahani-Azizabadi
- 265 *In vitro* gas production parameters of chickpea (*Cicer arietinum* L.) by-product  
E Abdi Ghezeljeh, M Danesh Mesgaran
- 266 Use of *in situ* technique to evaluate three weed forages  
M Kazemi, A M Tahmasbi, R Valizadeh, A R Vakili, M M Moheghi
- 267 Kinetic of *in vitro* gas production of high fat sunflower meal treated with sodium hydroxide and or formal dehyde by rumen bacteria+protozoa  
M Bojarpour, T Mohammadabadi, M Danesh Mesgaran, M Chaji
- 268 The kinetic of *in vitro* gas production of tannic acid treated sunflower meal with or without polyethylene glycol  
T Mohammadabadi, M Chaji, S Tabatabaei
- 269 Nitrogen fractionations, *in situ* ruminal degradation and post-ruminal crude protein disappearance of over heat and overheat-xylose processed guar meal  
H Jahani-Azizabadi, M Danesh Mesgaran, A R Vakili, M Vatandoost, M Mojtahedi, E Abdi Ghezeljeh, A Hojjat Panah, A Fanaie-Nokar
- 270 *In vitro* first order dry matter disappearance kinetics of chemically and physically treated cottonseed hulls  
A Famarzi Garmroodi, M Danesh Mesgaran, A R Vakili, A R Heravi Moussavi, A Tahmasbi, H Jahani-Azizabadi
- 271 Use of white rot fungi to improve the feed value of rice straw  
J W Cone, J J P Baars, A S M Sonnenberg
- 272 Cultivation of oyster mushrooms (*Pleurotus* species) to improve the *in vitro* dry matter digestibility of wheat straw for feeding to ruminants  
H Omed, A Avagyan, M Hale, J Gibbons
- 273 Evaluation of condensed tannin content of some native tanniniferous plants from semi-arid regions in Brazil  
R C Lucas, A L Abdalla, M E Q Vieira, J D F Gomes, M R R S Peçanha, M T Lima, R Moura, B Berenchtein, A S Morsy, Y A Soltan
- 274 Chemical composition and dry matter degradability coefficients of Fennel seed  
M Kazemi, A M Tahmasbi, R Valizadeh, M Danesh Mesgaran, A A Naserian