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NUTRITIONAL ASSESSMENT OF DIFFERENT FIELD PEA GENOTYPES (*PISUM SATIVUM* L.)

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Abstract

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The aim of this study was to determine the dry matter (DM), ash, organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF), total sugars, starches and estimate the metabolizable energy (ME), in ruminants, pigs, poultry, horses and pets (dogs and cats) and digestible energy (DE) in rabbits from the 10 most productive field pea genotypes (*Pisum sativum*) obtained in a trial with 4 X 20 different genotypes (Project 0186_AGROCELE_3_E).

The results (% DM - genotype) allowed us to state the following: all the 10 field pea genotypes grain were an important source of energy (cytoplasmic carbohydrates) with high percentages of soluble sugars (7.95% ISARD to 9.42% ENDURO) ($P<0.05$) and starch (38.63% LIVIA to 45.00% AUDIT) ($P<0.05$), low CF content (5.99% ISARD to 7.90% CARTOUCHE) ($P<0$ 05), high CP (22.8% ENDURO to 26.1% CORRENT) ($P<0.05$), low levels of EE (0.69% LIVIA to 1.62% CHEROKEE) ($P<0.05$), ideal level of ME ruminants (11.844 MJ/kg DM - CHEROKEE to 11.883 MJ/kg DM - CORRENT) ($P<0.05$), ME pigs (14.683 MJ/kg DM - ISARD to 13.885 MJ/kg DM - CARTOUCHE) ($P<0.05$), ME poultry (11.540 MJ/kg DM - LIVIA to 12.868 MJ/kg DM - AUDIT) ($P<0.05$), ME horse (11.392 MJ/kg DM - CORRENT to 11.979 MJ/kg DM - AUDIT) ($P<0.05$), ME pets (13.116 MJ/kg DM – CORRENT to 13.498 MJ/kg DM - ISARD) ($P<0.05$) and DE rabbits (12.977 MJ/kg DM - CARTOUCHE to 13.044 MJ/kg DM - ISARD) ($P<0.05$).

We concluded that all 10-field pea genotypes are an excellent feedstuff for ruminants and non-ruminants animal and it could be supplied plain or included in concentrate feed because it is an excellent protein and energy supplement. It combines in the same grain high levels of crude protein and starch. Due to the low fat content is a very interesting pulse for pets' light diets.

Key words: field pea; *Pisum sativum*; animal feed; nutritive value

Introduction

Field pea (*Pisum sativum* L.) is a cool season legume crop of mild climate regions that convert nitrogen from the atmosphere into nitrogen nodules on the plant roots. It is an important edible legume seed or "pulse crop" for human and animal nutrition. Conversely, soybean meal is the major protein source in non-ruminants and dairy cow diets. All soybean meal used by the feed industry in Iberia Peninsula is imported and the debate about genetically modified soybean and the fluctuating world market prices remains a major concern. However a locally grown protein source such as field pea offer the greatest potential and will give the feed industry more stability and add flexibility in diet formulations (Rodino et al., 2009).

The world production of field pea is rapidly increasing and a greater quantity of this pulse crop is now

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available for animal feeding. According to FAO 2004 data, about 12.2 millions tones of pea production were achieved in 6.3 million ha agricultural lands of the world with an average yield of 1.93 tones/ha (Anonymous, 2007 cited by Duzdemir et al., 2009).

The *Pisum sativum* subspecie *hortense* with white flowers is the field pea most used in feed industry in Iberia Peninsula and has low antinutritional factors as trypsin inhibitors and tannins. This raw material is mainly imported from Australia, France and more recently from China and Canada (FEDNA, 2003). Field pea trypsin inhibitors could be different among genotypes and field pea genotypes with low trypsin inhibitors would be more suitable for use as animal feed (Wang et al., 1998; Grosjean et al., 2000; Morrison et al., 2007; Nalle et al., 2011). Field peas has been used in production of concentrated feed for aquaculture (Cruz-Suarez et al., 2001; Thiessen et al., 2003; Allan and Booth, 2004; Adamidou et al., 2009), pigs (Brand et al., 2000; Stein et al., 2004; Petersen and Spenser, 2006), poultry (Wiryawan and Dingle, 1999; Nalle et al, 2011) and pet animals like dogs and cats (Bednar et al., 2001; De-Oliveira et al., 2008; Carciofi et al., 2008).

The nutritional composition of field peas is well documented. However, like with antinutritional factors depending on field pea genotype, we must evaluate the nutritional profile of the different genotypes grown in Iberia Peninsula. It could be useful for accurate feed formulation because interaction of cultivars, soil, climate and agronomic factors can cause appreciable differences in nutrients profiles between locally grown gradients and those available around the world. The present study characterized the nutrient profile and the energetic value of 10 field pea genotypes grown under non-irrigation condition in Iberia Peninsula (39º 49’ 17’’ N; 07º 27’ 44’’ W).

Material and Methods

Twenty different field pea genotypes (*Pisum sativum* L.) were grown under non-irrigation condition during growing season 2009-2010 at School of Agriculture farm (39º 49’ 17’’ N; 07º 27’ 44’’ W) of the Polytechnic Institute of Castelo Branco (Reis and Rodrigues 2011). This location has a Temperate Mediterranean climate. The soil type is granite with medium level of organic matter (2.3%) and pH 6.3. Phosphorus and potassium fertilizers were applied at the rate of 60 kg P_2O_5/ha and 60 kg K_2O/ha. The seeds were sown at the end of November. The experimental design was a randomized complete block with 4 replications. Plots (12 m^2) were 6 rows spaced 0.25 m apart and 30 cm between plants (plant density 110/m^2). When necessary, weeds were controlled by hand. At maturity (end of May / beginning of June), each plot were harvested manually, sun dried for one week and threshed manually. The seeds were cleaned from dust and other foreign materials and stored at the room temperature for analysis.

One sample of each replication of the 10 most productive field pea genotypes were chemical analyzed for: moisture, total ash (Ash), crude protein (CP) and ether extract (EE) according to the methods of Association of Official Analytical Chemists (AOAC, 2000). The CP was calculated as taken percent nitrogen by 6.25. The organic matter (OM) was determined based on dry matter (DM) and TA. Seeds total sugar and starch were determined according to McCready et al. (1950) and crude fiber (CF) according to AOAC (1990) (Table 1).

Metabolizable energy (ME) for ruminants, pigs, poultries, horses and pets (dogs and cats) was calculated by prediction equations described by Alderman (1985) ($ME = 11.78 + 0.00654 \times CP + (0.000665 \times EE)^2 - CF \times (0.00414 \times EE) - 0.0118 \times Ash$), Morgan et al. (1975) (ME (kcal/kg DM) $= 99.5 \times CP + 144.7$ x EE

Table 1
Code and individual production of the 10 field pea genotype evaluate in this study (Reis and Rodrigues, 2011)

Genotype	Code	Production (kg/ha)
CARTOUCHE	FR 9295	6670
ENDURO	FR 8444	6509
AUDIT	FR 13262	6400
CORRENT	IT 2	6374
ALHAMBRA	ES 225	5933
CHEROKEE	FR 11553	5920
ISARD	FR 9504	5846
LIVIA	FR 8451	5822
GREGOR	DE 147	5736
JAMES	FR 9295	5435

+ 87.8 x NFE – 4795), Fisher and McNab (1987) (ME (MJ/kg DM) = 0.1551CP + 0.3431EE + 0.1669Starch + 0.1301Sugar), Kienzle and Zeyner (2010) (ME (MJ/kg DM) = -3.54 + 0.0129 x CP + 0.042 x EE – 0.0019 x CF + 0.0185 NFE (crude nutrients in g/kg DM)) and AAFCO (1997) (ME (kcal/kg DM) = 10 x (3.5 x CP + 8.5 x CF + 3.5 x NFE) equations, respectively. Digestible energy (DE) for rabbits was calculated by prediction equations described by Wiseman et al. (1992) (DE (MJ/kg DM) = 12.912 – 0.0236CF + 0.01CP + 0.02EE). Nitrogen free extract was determined using the equation NFE (%) = 100 – (CP + EE + CF + Ash).

Data were statistically analyzed using one way ANOVA and Duncan's Multiple Range Test (IBM SPSS ver. 19).

The aim of this study were to evaluate the nutrition profile of field pea grain as a protein and energy source of diets for ruminant and non-ruminant animals, comparing the 10 different genotypes among themselves and with published values.

Results and Discussion

Chemical composition

From Table 2 it is evident the high level of starch content 40.955% DM (±1.841) (P<0.05) (ranging from 38.638% in LIVIA to 45.006% DM in AUDIT genotype) and the amount of soluble carbohydrate 8.808% DM (±0.423) (P<0.05) (ranging from 7.951% in ISARD to 9.421% DM in ENDURO genotype). Those values indicate that field pea is an important source of available energy. Field pea starch had higher amylose, greater swelling power and solubility, and lower pasting temperatures than other grain legumes starches (Gujska et al., 1994). It has been characterized as slowly digested (Bednar et al., 2001), which may benefit glucose-insulin metabolism in pig and pets like dogs and cats (de-Oliveira et al., 2008; Carciofi et al., 2008). Comparing these results with field pea values presented by Chamberlain and Wilkinson (1996) (44% DM), FEDNA (1999) (50.17% DM), FEDNA (2003) (46.18% DM) and De Blas et al. (2009) (48.24% DM) our figures are a little bit lower. Comparing with others legume and cereal seeds field pea starch content is much higher than *Lupinus angustifolius* (1.43% DM), similar to oat (40.67% DM) and faba bean (41.10% DM) (De Blas et al., 2009), lower than lentil (46.02% DM) (FEDNA, 1999), rye (55.04% DM) and barley (59.35% DM) and much lower than cereal grains like wheat (67.95% DM) and corn (73.43% DM) (De Blas et al., 2009). Our results on field pea soluble carbohydrate content were higher when compared with Chamberlain and Wilkinson (1996) (2.50% DM), FEDNA (1999) (5.77% DM), FEDNA (2003) (3.99% DM) and De Blas et al., (2009) (3% DM).

In addition it can be seen that field pea CF content is not too high 7.106% DM (±0.716) (P<0.05) (ranging

Table 2
Chemical composition of some selected field pea genotypes grain

Genotype	DM, %	Ash, %DM	OM, %DM	CP, %DM	EE, %DM	CF, %DM	Sugar, %DM	Starch, %DM
ALHAMBRA	90.51	3.530^{d}	96.805^{c}	25.034^{f}	1.519^{h}	7.066^{c}	8.662^{c}	39.736^{c}
AUDIT	90.41	3.368^{a}	96.955^{e}	24.271^{d}	1.405^{g}	6.509^{b}	8.533^{b}	45.006^{i}
CARTOUCHE	90.32	3.454^{b}	96.880^{d}	23.090^{b}	1.063^{d}	7.900^{e}	8.907^{e}	41.159^{f}
CHEROKEE	90.50	3.630^{e}	96.715^{b}	24.557^{e}	1.624^{i}	7.862^{e}	8.729^{c}	42.403^{h}
CORRENT	90.53	3.629^{e}	96.715^{b}	26.162^{g}	0.768^{b}	7.898^{e}	9.400^{f}	38.882^{b}
ENDURO	90.22	3.392^{a}	96.940^{e}	22.851^{a}	1.059^{d}	7.376^{d}	9.421^{f}	40.695^{de}
GREGOR	90.15	3.466^{bc}	96.875^{d}	25.009^{f}	0.860^{c}	6.062^{a}	8.819^{d}	40.832^{e}
ISARD	90.68	3.518^{cd}	96.810^{c}	24.997^{f}	1.185^{f}	5.999^{a}	7.951^{a}	40.516^{d}
JAMES	90.54	3.529^{d}	96.805^{c}	23.203^{b}	1.143^{e}	7.290^{d}	8.963^{e}	41.678^{g}
LIVIA	90.30	3.704^{f}	96.655^{a}	23.995^{c}	0.698^{a}	7.099^{c}	8.693^{c}	38.638^{a}
Mean	90.416	3.522*	96.816*	24.317*	1.132*	7.106*	8.808*	40.955*
±sd	±0.165	±0.108	±0.099	±1.050	±0.312	±0.716	±0.423	±1.841

Each value is the mean of 4 field pea genotype replicates; sd – standard deviation; * significantly different at 0.05 level; different letters in the same column means P<0.05 using Duncan's Multiple Range Test.

from 5.999% in ISARD genotype to 7.900% in CARTOUCHE genotype) and is identical to field pea CF values presented by MAFF (1975) (6.30% DM), FEDNA (1999) (6.57% DM), FEDNA (2003) (6.50% DM) and De Blas et al., (2009) (6.81% DM). CF content in the 10 field pea genotypes were lower than seeds like *Lupinus albus* (11.9% DM), *Lupinus luteus* (17.8% DM) (Ribeiro and Melo, 1990), *Lupinus angustifolius* (16.21% DM), oats (14,00% DM) and faba bean (9.93% DM) and higher than barley (5.26% DM), wheat (2.93% DM), corn (2.67% DM) and rye (2.47% DM) (De Blas et al., 2009), lentil (4.66% DM) (FEEDNA, 1999), and chickpea (4.3% DM) (Ribeiro and Melo, 1990).

Table 2 shows that the field pea CP content is high 24.317% DM (±1.050) ($P<0.05$) ranging from 22.851% DM (ENDURO genotype) to 26.162% DM (CORRENT genotype) and compares well with CP field pea figures from other workers 26.2% DM (MAFF, 1975), 25.2% DM (AFRC, 1993), 26.1% DM (Chamberlain and Wilkinson, 1996), 24.8% DM (FEDNA, 1999) and 23.4% DM (FEDNA, 2003; De Blas et al., 2009) but it is higher than 21.0% DM (Ribeiro and Melo, 1990), 21.3% DM (Cruz-Suarez et al., 2001) and 20.0% DM (Stein et al., 2004). Field pea CP is similar to other protein sources like chickpea (18.2 - 24.0% DM) and *Lupinus albus* (24% DM) (Ribeiro and Melo, 1990), faba bean (27.6% DM) (De Blas et al., 2009), lentil (27.7% DM) (FEDNA, 1999), but much lower than *Lupinus angustifolius* (33.4% DM) (De Blas et al., 2009) and *Lupinus albus* var.931-S (34.4% DM) (Ribeiro and Melo, 1990). As expected, the CP content of field pea is much higher than CP content of cereals such as corn (8.7% DM), oat (9.7% DM), barley (10.8% DM) and wheat (11.5% DM) (De Blas et al., 2009). However, all the field pea genotypes combine a high protein (24.317% DM) and starch (40.955% DM) content in the same seed. This is very interesting from the standpoint of animal feed, mainly for ruminants, because in the same feed we found a source of protein and a source of easily fermentable carbohydrates, slowly digested starch (Bednar et al., 2001).

The low fat content (1.132% DM ±0.312; $P<0.05$) (Table 2) is a small contribution for non-ruminant energy fraction but field pea seems be an interesting grain for light pet's diets. The low level of fat does not represent a limiting factor in ruminant nutrition, especially for the adequate ecological conditions of the rumen bacteria. In some field pea genotypes like CHEROKEE (1.624% DM), the EE content is twice the EE found in field pea genotypes LIVIA (0.698% DM) and CORRENT (0.768% DM). Our results were similar to those EE field pea obtained by MAFF (1975) (1.90% DM), AFRC (1993) and Chamberlain and Wilkinson (1996) (1.40% DM), FEDNA (1999) (1.73% DM), FEDNA (2003) (1.71% DM) and De Blas et al. (2009) (1.59% DM). Comparing these results with the values obtained for other legume grains, field pea has an EE content similar to faba bean (1.26% DM) (De Blas et al., 2009) and lentil (1.59% DM) (FEDNA, 1999) and lower than chickpea (4.31% DM) (Ribeiro and Melo, 1990) and *Lupinus angustifolius* (6.06% DM) (De Blas et al., 2009). Field pea EE is also similar to some cereal grains like rye (1.46% DM), triticale (1.58% DM), wheat (1.81% DM) and barley (2.02% DM) but lower than corn (4.18% DM) and oat (5.44% DM) (De Blas et al., 2009).

Digestible and metabolizable energy

It is evident that field pea seeds are a very good feedstuff as energy supplier for ruminant and non-ruminant animals (Table 3). It can be included as concentrate component. According to the animal species, all the field pea genotypes have identical energetic value. The average ME for ruminants was 11.864 MJ/kg DM (±0.091) ($P<0.05$) ranging from 11.883 MJ/kg DM (CORRENT genotype) to 11.844 MJ/kg DM (CHEROKEE genotype). The ME for pigs was 14.229 MJ/kg DM (±0.300) ($P<0.05$) ranging from 14.683 MJ/kg DM (ISARD genotype) to 13.885 MJ/kg DM (CARTOUCHE genotype). The ME for poultry was 12.141 MJ/kg DM (±0.361) ($P<0.05$) ranging from 11.540 MJ/kg DM (LIVIA genotype) to 12.868 MJ/kg DM (AUDIT genotype). The ME for horses was 11.763 MJ/kg DM (±0.174) ($P<0.05$) ranging from 11.392 MJ/kg DM (CORRENT genotype) to 11.979 MJ/kg DM (AUDIT genotype). The ME for pet (dogs and cats) was 13.324 MJ/kg DM (±0.129) ($P<0.05$) ranging from 13.116 MJ/kg DM (CORRENT genotype) to 13.498 MJ/kg DM (ISARD genotype). The DE for rabbits (including pet rabbits) was 13.010 MJ/kg DM (±0.022) ($P<0.05$) ranging from 12.977 MJ/kg DM (CARTOUCHE genotype) to 13.044 MJ/kg DM (ISARD genotype).

The results show that the most energetic and suitable field pea genotypes for fattening pigs and poultries are respectively, ISARD and AUDIT. For fattening cattle, the better field pea genotype is CORRENT. However, the small difference between ME estimated for ruminants, pigs and poultry allow us to say that the results on fattening cattle, pigs or poultry will be similar using any field pea genotype. With regard to horses,

Table 3
Estimated digestible energy (DE) and metabolizable energy (ME) of some selected field pea genotypes (MJ/kg DM)

Genotype	ME Ruminant (a)	ME pig (b)	ME poultry (c)	ME horse (d)	ME pet (e)	DE rabbit (f)
ALHAMBRA	11.857^{c}	14.368^{d}	12.162^{e}	11.820^{e}	13.410^{d}	13.025^{f}
AUDIT	11.861^{d}	14.567^{e}	12.868^{g}	11.979^{g}	13.491^{e}	13.029^{f}
CARTOUCHE	11.855^{b}	13.885^{a}	11.974^{b}	11.666^{bc}	13.203^{b}	12.977^{a}
CHEROKEE	11.844^{a}	14.040^{b}	12.578^{f}	11.691^{c}	13.300^{c}	13.004^{e}
CORRENT	11.883^{g}	13.902^{a}	12.033^{c}	11.392^{a}	13.116^{a}	13.002^{e}
ENDURO	11.857^{c}	14.088^{bc}	11.925^{b}	11.796^{de}	13.288^{c}	12.987^{b}
GREGOR	11.881^{f}	14.601^{e}	12.136^{e}	11.883^{f}	13.428^{d}	13.036^{g}
ISARD	11.872^{e}	14.683^{f}	12.080^{cd}	11.964^{g}	13.498^{e}	13.044^{h}
JAMES	11.855^{b}	14.107^{c}	12.113^{de}	11.789^{d}	13.298^{c}	12.994^{c}
LIVIA	11.872^{e}	14.045^{b}	11.540^{a}	11.646^{b}	13.207^{b}	12.998^{d}
Mean	11.864*	14.229*	12.141*	11.763*	13.324*	13.010*
±sd	±0.013	±0.300	±0.361	±0.174	±0.129	±0.022

(a) Alderman (1985) (ME = 11.78 + 0.00654 × CP + $(0.000665 \times EE)^2$ – CF × (0.00414 × EE) − 0.0118 × Ash); **(b)** Morgan et al. (1975) (ME (kcal/kg DM) = 99.5 × CP + 144.7 x EE + 87.8 x NFE – 4795); **(c)** Fisher and McNab (1987) (ME (MJ/kg DM) = 0.1551CP + 0.3431EE + 0.1669Starch + 0.1301Sugar); **(d)** Kienzle and Zeyner (2010) (ME (MJ/kg DM) = -3.54 + 0.0129 x CP + 0.042 x EE – 0.0019 x CF + 0.0185 NFE (crude nutrients in g/kg DM)); **(e)** AAFCO (1997) (ME (kcal/kg DM) = 10 x (3.5 x CP + 8.5 x CF + 3.5 x NFE); **(f)** Wiseman et al. (1992) (DE (MJ/kg DM) = 12.912 – 0.0236CF + 0.01CP + 0.02EE).
Each value is the mean of 4 field pea genotype replicates; sd – standard deviation; * significantly different at 0.05 level; different letters in the same column means $P<0.05$ using Duncan's Multiple Range Test.

Table 4
Estimated metabolizable energy (ME) and digestible energy (DE) of some legume and cereal grains (MJ/kg DM)

Author	**Legume**	ME Ruminant (a)	ME pig (b)	ME poultry (c)	ME horse (d)	ME pet (e)	DE rabbit (f)
De Blas et al., 2009	Field pea	11.85	14.53	12.74	12.05	13.51	13.02
FEDNA 2003	Field pea	11.85	14.67	12.44	12.14	13.58	13.03
FEDNA 1999	Field pea	11.86	14.72	13.56	12.05	13.58	13.04
De Blas et al., 2009	Faba bean	11.87	13.34	12.12	11.01	12.92	12.98
FEDNA 1999	Lentil	11.90	15.61	12.97	12.28	13.86	13.11
De Blas et al., 2009	*L. angustifolius*	11.56	12.70	7.93	10.66	13.10	12.98
	Cereal						
De Blas et al., 2009	Barley	11.78	14.80	12.50	13.28	13.92	12.94
De Blas et al., 2009	Corn	11.78	16.55	15.08	14.58	14.88	13.02
De Blas et al., 2009	Oat	11.49	12.12	10.37	12.25	13.26	12.79
De Blas et al., 2009	Rye	11.81	15.93	12.77	13.92	14.33	12.98
De Blas et al., 2009	Wheat	11.81	15.93	13.97	13.81	14.33	12.99

(a) Alderman (1985) (ME = 11.78 + 0.00654 × CP + $(0.000665 \times EE)^2$ – CF × (0.00414 × EE) − 0.0118 × Ash); **(b)** Morgan et al. (1975) (ME (kcal/kg DM) = 99.5 × CP + 144.7 x EE + 87.8 x NFE – 4795); **(c)** Fisher and McNab (1987) (ME (MJ/kg DM) = 0.1551CP + 0.3431EE + 0.1669Starch + 0.1301Sugar); **(d)** Kienzle and Zeyner (2010) (ME (MJ/kg DM) = -3.54 + 0.0129 x CP + 0.042 x EE – 0.0019 x CF + 0.0185 NFE (crude nutrients in g/kg DM)); **(e)** AAFCO (1997) (ME (kcal/kg DM) = 10 x (3.5 x CP + 8.5 x CF + 3.5 x NFE); **(f)** Wiseman et al. (1992) (DE (MJ/kg DM) = 12.912 – 0.0236CF + 0.01CP + 0.02EE).

dogs, cats and pet rabbits the owner do not want them getting fat. To feed that animal will be advantageous field pea genotypes that provide less energy like CORRENT for horses, dogs and cats and CARTOUCHE for pet rabbits.

Applying the same equations to predict ME and DE to other feedstuff we found the results shown in Table 4. We found no differences regarding ME ruminant, ME pig, ME poultry, ME horse, ME pet and DE rabbit values presented by others. Comparing our field pea results with ME and DE values of other legume and cereal grains (Table 4) we found no differences regarding ME ruminant and DE rabbit. Field pea only has more metabolizable energy than faba bean (13.34 MJ/kg DM), *Lupinus angustifolius* (12.70 MJ/kg DM) and oat (12.12 MJ/kg DM). In addition, the field pea ME poultry was only higher than oat (10.37 MJ/kg DM) and *Lupinus angustifolius* (7.93 MJ/kg DM) metabolizable energy. ME horse and ME dogs and cats of field pea were higher than faba bean (11.01 and 12.92 MJ/kg DM) and *Lupinus angustifolius* (10.66 and 13.01 MJ/kg DM) metabolizable energy.

Conclusion

According to these results, we concluded that all 10 field pea genotypes are a very good energy substrate for ruminant diets and can be included as component of concentrate feed. It looks like not only the starch and protein but also soluble carbohydrates, fat and fiber are available in ideal quantities to promote a good fermentation in the rumen. Field peas also could be used as feedstuff energy supplier for non-ruminants. However, the main nutritive possibility of field pea seems to be as a protein supplement, in particular for non-ruminant animals (pigs, poultry, rabbits and dogs). All 10 field pea genotypes could be included in a concentrate feed because it is an excellent protein supplements since it combines in the same grain, high levels of crude protein and small quantity of fat. This is particularly important for dogs and rabbits' light diets where it is necessary to prevent getting fat.

Depending on the market price field pea may totally or partially replace corn (as a source of easily fermentable carbohydrates) and soybeans (as the main source of protein). Future studies must be conducted to determine the existence of antinutritional factors in these 10 filed pea genotypes.

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