Nutritional values of extruded rapeseed and pea for broiler chicken.

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ABSTRACT

Rapeseed and pea were extruded following different conditions of temperature, steam injection, and specifical mechanical energy. Metabolizable Energy (ME) measured on rooster was inproved from 10 to 20% by the treatment, on account of better digestibility of starch and lipids. Dry extrusion tended to alter protein utilization. No difference could be observed on growth performances of chickens.

INTRODUCTION

Incorporation of whole rapeseed brings about an increase of energy level of broiler chicken food, but the high fat level of whole seeds (40-50% of dry matter) leads to technological difficulties (crushing, pellets quality, etc...). Extrusion combines mechanical and thermic treatment, and leads to changes of cellular structure and molecular modifications of raw materials. Since 1989, CETIOM and INRA have carried out studies on effects of extrusion on nutritional values of whole rapeseed mixed with pea (source of starch).

EXPERIMENTAL

Extrusion

Temperature (°C), Specific Mecanical Energy (SME W/h/kg) and vapor injection level (% of raw material weight) can be measured and recorded by sensor equipment placed on the extrusion installation. Four moist treatments have been conducted, combining two levels of steam injection (5 and 10%) and two levels of SME (30 and 60 W/h/kg) on a 50%/50% rapeseed/pea mixture (extrusions n°1 to 4).

For treatment n°5, dry extrusion at 160°C, of a 50/50 moistened rapeseed/pea mixture was tested : moistening allows a higher extrusion flow rate. Dry extrusion has been conducted at 110, 130 and 150°C, on a 50/50 rapeseed/pea mixture (extrusion n° 8, 7, 6 respectively). Extrusion of a 30/70 rapeseed/pea mixture has been conducted at 130°C (n°9).

Technological parameters recorded during extrusion are presented in table 1 : we note that when the same level of mechanical energy is transmitted to products, steam injection leads to higher temperature levels.

Table 1 : extrusion parameters

		oC	%	Energy (W/h/kg)		
	Pea/Rape	Temp	Steam	SME	Steam	Total
1	50/50	168	9	61	69	129
2	50/50	155	4	61	35	96
3	50/50	144	10	31	76	107
4	50/50	125	5	30	39	70
5	50/50	158	Moistened	101	0	101
6	50/50	152	0	81	0	81
7	50/50	132	0	65	0	65
8	50/50	113	0	57	0	57
9	70/30	132	0	61	0	61

Digestibility estimations :

Digestibility measurements of energy, nitrogen, lipids, starch are conducted on 8 adult roosters for each diet, placed in individual cages, feeding ad-libitum. Experimental diets contains 30% of one of the tested products : crude rapeseed, crude pea, crude 50/50 rapeseed/pea mixture, and extrusion treatment n°1 to 9. First, rooster receive the diets during a three days adaptation period. The experimental period lasts 4 days : 24 hours fasting, two days receiving experimental diets, and then 24 hours fasting again. Excreta are collected during the last three days of experimental period. Diets and excretas are analysed for crude energy, total protein, starch and fat contents.

RESULTS AND DISCUSSION :

Chemical composition and nutritional values of products are reported in table 2 :

Table 2 : Chemical composition and nutritional values of products

	DM	Fats	Prot	Ash	GLS	ME	Digestibility (%) of		
	%	% DM	% DM	% DM	umol/g	kcal/gDM	Prot	Starch	Fats
Rape	92.4	45.2	22.0	2.6	15.3	3930	74	.	67.2
Pea	87.5	1.9	21.8	4.9	.	2926	83.8	86.6	87.4
0	91	21.9	21.2	.	.	3808 c	77.9 ab	90.2	84.0
1	91.9	23.0	22.4	3.9	5.4	4262 a	77.3abc	.	.
2	92.0	23.0	22.4	3.8	7.1	4085 b	77.2abc	.	.
3	90.5	24.1	22.4	3.7	6.7	4197 ab	77.5 abc	96.5	92.5
4	91.1	23.7	22.7	3.6	7.3	4100 b	(72.8 d?)	93.7	92.5
5	91.4	22.7	22.6	3.7	5.8	4181 ab	78.0 ab	96.8	92.1
6	95.1	24.3	21.5	3.6	7.2	4206 ab	75.8 bc	.	.
7	94.3	24.4	21.1	3.7	.	4286 a	75.8bc	94.7	94.8
8	93.8	24.0	21.7	3.7	.	4147 ab	74.8 cd	.	.
9	94.0	15.4	21.3	3.5	.	3888 c	78.8 a	.	.

Metabolizable enrgy (ME) of crude rapeseed is 3930kcal/kgDM, which is about 500kcal less than previous reported values (Lessire M., INRA, unpublished). Several factors can produce variability of ME estimation : grinding technology, effect of fat level in diet... Low lipid digestibility of crude rapeseed here (67%) may result from a weak grinding technology, leading to a low level of cellular change of the seed.

Extrusion improves digestibility of fat from 50/50 rape/pea mixture from 8 to 11 points. With a Crude Energy level of 9550kcal/kgDM of vegetable oil, this difference of digestibility between products can explain 170 to 230kcal/kgDM of ME. Starch digestibility of pea is also improved by extrusion from 4 to 6 points (gelification of starch), which account for 40 to 70kcal/kgDM of amelioration of ME of the 50/50 mixture (Crude Energy of starch : 4200kcal/kgDM).

Dry extrusion significantly improves ME (+400kcal/kgDM). Temperature has no significant effect, but a level of 130°C seems to be optimum. Nitrogen digestibility is reduced from 2 to 3 points by dry extrusion.

High level of steam injection improves ME from 200kcal/kgDM, whatever the level of mechanical energy (SME : 30 or 60W/h/kg) : treatment 1 vs 2 and 3 vs 4. For 10% vapor injection and temperature of 144 to 168°C, ME of the mixture is as good as those of dry extruded products (4200 to 4290kcal/kgDM). Digestibility of proteins is not altered by vapor treatment 1 to 4, compared with the control diet (treatment 0). Vapor injection at a given temperature leads to higher extrusion flow rate, and correlatively to lower mechanical energy transmitted to products : this may explain protection effect on the protein fraction.

CONCLUSION :

Moderate dry extrusion (temperature around 130°C) leads to correct structural and chemical modifications of raw materials, and good nutriment digestibility. Vapor injection during extrusion leads to better flow rate, and has a protection effect on protein fraction. Growth tests made subsequently on broiler chicken have not confirmed positive effects of extrusion on growth performance and diet efficiency.

RÉFÉRENCES :

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