

# EFFECTS OF CRUSHING CONDITIONS ON SUNMEAL QUALITY

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## ABSTRACT

Four different oil-extraction processes have been applied to a batch of sunflower seeds, in the pilot plant of CETIOM. The conditions have been chosen with the aim of protecting the proteins from ruminal degradation. They involved cooking temperature (90°C or 130°C) and desolventation parameters (temperature and steam output). Furthermore, 15 regular sunmeals have been collected on feed market.

On these total of 19 sunmeals, classical chemical analyses have been done, as well as determinations of *in sacco* degradation of dry matter and nitrogen in cows.

**KEYWORDS** : sunflower, process, protein quality, feed, ruminants,

## INTRODUCTION

A feedstuff with a high protein content is interesting in compound feed for ruminants if these proteins are not fully hydrolyzed in the rumen and can be digested in the small intestine to provide animals with essential amino acids. Ruminants consume approximatively 45% of sunmeals used in French animal feeding. Unfortunately, sunmeals are largely degraded in rumen : 77% vs 62% for regular soybean meal and 35% for formaldehyde-treated soybean meal.

Some studies have been done since 1980, with the aim of a better knowledge of relationships between crushing process parameters and nutritional value of meal, by ruminants and monogastrics. The main studies have been done in France (B. Michalet-Doreau, INRA - EURETEC), in Canada (J.R. Ingalls, University of Manitoba, Winnipeg - J.J. McKinnon, University of Saskatchewan, Saskatoon - B.M. Mosimanyana, University of Guelph), in Sweden (M. Emanuelson, University of Uppsala), in Finland (A.O. Vanhatalo, University of Jokionen) and in Poland (H. Kozłowska, University of Olsztyn)

## EXPERIMENTAL DESIGN

In this study, 4 different oil-extraction processes have been applied to a batch of non-dehulled sunflower, in the CREOL oil mill pilot plant, which is a part of the French oilseeds organization. Chosen conditions aimed at protecting the proteins from ruminal degradation. They involved cooking temperature and desolventation parameters. Furthermore, 15 regular sunmeals have been collected on the feed market.

Classical chemical analyses have been made on these total of 19 sunmeals. *In sacco* degradation of dry matter and nitrogen in cows has been determined on the 4 pilot meals and on the 4 market meals.

## RESULTS

### Experimental crushing conditions

The purpose of the pilot work was to fit the crushing parameters for reducing the degradation of protein in rumen and keeping a good digestibility in the small intestine. The aim was also to have a better knowledge of the specific effects of heat treatments : cooking before pressing and desolventation (Table 1). In order to do so, two cooking temperatures before pressing were chosen : low (90°C) and high (130°C). The low cooking temperature was followed by drastic conditions of desolventation (steam injection up to 105°C and then, provided during 30 minutes : T90A and T90B). The high cooking temperature was followed either by mild conditions of desolventation (steam injection up to 105°C and then, stopped : T130A), either by drastic conditions of desolventation (steam injection up to 105°C and then, provided during 30 minutes : T130B).

**Table 1 : Crushing parameters**

Cooking temperature	90°C		130°C	
<b>Desolventation</b>				
Temperature maximum	118°C	118°C	105°C	121°C
<b>References</b>	T90A	T90B	T130A	T130B

### Analytical and nutritional characteristics of sunmeals

The Table 2 shows the main chemical characteristics of meals. Some of the market sunmeals were partially dehulled, which explains the lower average fiber content of these meals : 26.7% vs 34% in average for meals processed in the pilot plant. Nevertheless, the 4 market meals used for determinations of *in sacco* degradation were non-dehulled.

The lowest protein degradation was obtained for the meal T130B (high cooking temperature followed by drastic conditions of desolventation) : 44% vs 71% for the market sunmeals. The optimum digestibility in the small intestine is obtained by this treatment : 93% vs 77 % for the market sunmeals.

**Table 2 : Composition of sunmeals and nutritional characteristics (% DM)**

	T90A	T90B	T130A	T130B	Market
DM	94.6	94.7	93.8	95.3	89.2*
Fat	0.7	0.8	0.5	0.5	2.2*
Crude Fiber	34.5	33.8	34.5	33.4	26.7*
Crude Protein	25.5	-	25.5	27.4	34.2*
N Degradability	55.7	56.8	49.4	44.0	71.1**
N Digestibility	90.2	90.9	90.9	92.6	77.1**

\* average of 15 samples

\*\* average of 4 samples

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The value for digestible protein in intestine (DPI) are reported in Table 3 : the highest value of the digestible protein in intestine is obtained with the meal T130B (187 g/kg DM vs 111 g/kg DM as recommended by INRA Tables).

**Table 3 : Influence of crushing technology on nutritional value of sunmeal**

	Rumen degradability of nitrogen (%)		Digestibility of nitrogen (%)		Digestible protein in intestine (g/kg DM)	
	average	min-max	average	min-max	average	min-max
4 pilot meals	51	44-57	91	90-93	166	148-187
4 market meals	71	68-75	77	74-81	126	115-146
INRA	77		80		111	
SB meal 48	62				254	
Protected SB meal	35				382	

However, such a treatment was not interesting for poultry feed as the digestibility of some amino acids measured in cockerels was reduced.

As for the regular sunmeals, their protein values for ruminants showed a large variation : the N degradability in the rumen ranged from 68% to 75%, while the N intestinal digestibility ranged from 74 to 81%. The value for proteine digestible in intestine ranged from 115 to 146 g/kg DM.

### ECONOMIC ASPECTS

Different economic simulations have been applied to ruminant feeding (Tables 4, 5 & 6). The increased value of processed sunmeal T130B has been evaluated in two economic situations (situation 1 : cheap soyabean meal cheap and situation 2 : expensive soyabean meal ). The study shows that decreased rumen degradability of protein results in a slight gain of interest price of sunmeal. This gain depends essentially on the soya market price.

**Table 4 : Economic conditions**

Feedstuffs	Market prices (FF/MT)	
	1	2
Wheat	880	920
Soya	1410	1940
Sunflower	780	860
Rapeseed	1040	1090
Corn feed	830	800
Citrus	630	570

**Table 5 : Increased value of sunmeal T130B (situation 1)**

T130B	Concentrate feed for production	Nitrogen complementation
Interest price (FF/MT)	790	830
Incorporation rate	3%	12%
Gain vs market price*	+ 1.3%	+ 6.4%

\* 780 FF/MT

**Table 6 : Increased value of sunmeal T130B (situation 2)**

<b>T130B</b>	<b>Concentrate feed for production</b>	<b>Nitrogen complementation</b>
Interest price (FF/MT)	900	860
Incorporation rate	5%	20%
Gain vs market price*	+ 5%	0%

\* 860 FF/MT

## **CONCLUSIONS**

These results show the role played by crushing technology for improvement of sunmeal quality. Nevertheless, the nutritional improvement is not followed by a significant economic gain. The same study has been conducted with rapeseed meal and led to more important economical interest. The sunmeal is probably less modified by the crushing technology in comparison to rapeseed meal.

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