Keywords: Pressing, Binder, Poultry feed

The influence of binders on the pressing behaviour of poultry feeds with a high fat content

1. Introduction

The influence of binders on the pressing behaviour of feeds is assessed in relation to a Control Feed with no binder.
Tests are conducted in a pilot workshop and in an industrial setting.
Two criteria are used to express pelleting characteristics: the durability of pellets and the press's efficiency (specific consumption)

2. Pilot workshop study

A mass-produced turkey formula is pelletised using a 15.8 kW pilot press, equipped with a 4/80 unit (Table 1).

Feed Composition %	Pilot tests	Plant tests No. 1	Plant tests No. 2
Wheat	37.4	25.1	13.0
Maize	5.2	8.5	16.6
Sorghum	00	15.0	150
Rapeseed	8.6	5.1	6.5
Soybean	0.0	8.0	5.0
Cassava	0.0	0.0	8.0
Soybean press cake 48	23.5	5.4	11.3
Rapeseed press cake	3.1	4.1	5.0
Peas	8.2	12.0	0.0
Corn distillers	0.0	5.0	5.0
Corn feed	0.0	0.0	2.0
Distillers dried grains with solubles (DDGS)	1.5	0.0	0.0
Meat meal	8.4	6.0	5.7
Fish meal	0.0	0.0	1.0
Oils or fats	3.7	4.4	4.4
Other	0.4	1.4	1.5
TOTAL	100	100	100
Fat content before pressing	9.8	7.7	7.6

Table 1 : Feed compositions for the tests

Tests are conducted at a constant press speed, in order to obtain a residence time for the feed in the unit that is identical for all treatments (4.3 seconds).

The durability of pellets is measured using a HOLMEN device.
An initial testing campaign enables 11 binders to be studied at three meal processing temperatures (60, 70, 80°C). The incorporation rates of binders are chosen on the basis of information provided by their suppliers and that available in the bibliography (Table 2).
The mixability of the 11 binders is assessed beforehand by calculating the theoretical coefficient of variation. This coefficient of variation takes account of the binder's incorporation rate, its true density and the number of particles per unit of weight.
A second testing campaign is carried out on four binders (L1, L2, L6 and L9). It enables the results of the first testing campaign to be verified and the influence of the binder's incorporation rates on the feed's pressing behaviour to be determined (Table 1). These tests are conducted at a constant processing temperature and with a constant residence time in the unit (80°C and 4.3 seconds).

2.1. Testing campaign no. 1: Assessment of 11 binders and the influence of steam incorporation rates

Only six binders (L1, L4, L6, L8, L9 and L10) have a good or average theoretical mixability (values below 10 %, Table 2).
The pressing tests reveal the overriding effect of steam incorporation rates on the feed's pressing behaviour: improvement in the cohesion of pellets and the press motor's electrical efficiency. This effect is greater than that of binders.
As regards the control feed, and irrespective of the processing temperature, the lignosulfites (L6 and L8) significantly improve the durability of pellets. Six binders have a negative effect on this criterion (L2, L3, L4, L5, L10 and L11), the other binders have a slightly positive influence (Figure 1).
Binders L2, L4 and L11 significantly reduce the press's specific consumption, while binder L10 has the reverse effect on this criterion. The other binders have no influence on the press's efficiency (Figure 1).

Product	Treatment	Theoretical coefficient of variation %	Incorporation rate Testing campaign no. 1	Testing campaign no. 2
L1	Sodium bentonite	7.5	2.0	1.0 and 3.0
L2	Calcium aluminate	15.0	1.0	1.5 and 2.0
L3	Modified starch	11.2	3.0	
L4	Gluten = modified starch	7.9	3.0	
L5	Vegetable gum	38.2	0.1	
L6	Purified lignosulfite	9.4	0.7	1.0 and 1.4
L7	Lignosulfite + Gum + Modified starch	17.6	0.2	
L8	Calcium lignosulfonate	9.1	1.5	
L9	Potato starch + Wheat gluten	5.4	3.0	1.5 and 4.5
L10	Pel plus 250 A (USA origin)	9.8	2.0	
L11	Carboxymethyl cellulose	36.9	0.2	
L12	Control feed without a binder		0.0	0

Table 2: Pilot workshop tests

2.2. Testing campaign no. 2: The influence of the incorporation rates of binders

The results are combined with those from the first series of tests undertaken at 80°C. Three binders stand out (Figure 2):

- Binder L6 (lignosulfite), which significantly improves the durability of pellets (binding effect).
- Binder L2 (calcium aluminate), which significantly improves specific production, but which causes a deterioration in the quality of pellets (lubricant effect).
- The plant-based binder L9, which improves the press's efficiency and has a minor and uniform influence on the durability of pellets.

The influence of the binder's incorporation rates on the durability of pellets is only observed with lignosulfite (L6).
Test averages at 60, 70, 80°C

3. Study in an industrial setting

Two testing campaigns are carried out on a 250 kW press, equipped with a 3.5/70 die. The formulae used appear in Table 1. The durability of pellets is determined using a quick-test device (20 seconds).
During the course of the first testing campaign, three binders are examined. The binders are incorporated into the feed in proportions of 0.75% for lignosulfite L8, 1.0% for calcium aluminate L2 and 3.0% for binder L9.
The pressing conditions are defined by the press operator, they are identical for all the processes. The processing temperature for the meal is 68°C and the press flowrate is 8t/h.
During the course of the second testing campaign, the influence of the press's operation is assessed in relation to that of lignosulfite L8 incorporated at 0.75%.
Pelleting the feed, with or without a binder, is carried out at two temperatures (66°C and 74°C) and two flowrates (7t/h and 8 t/h).

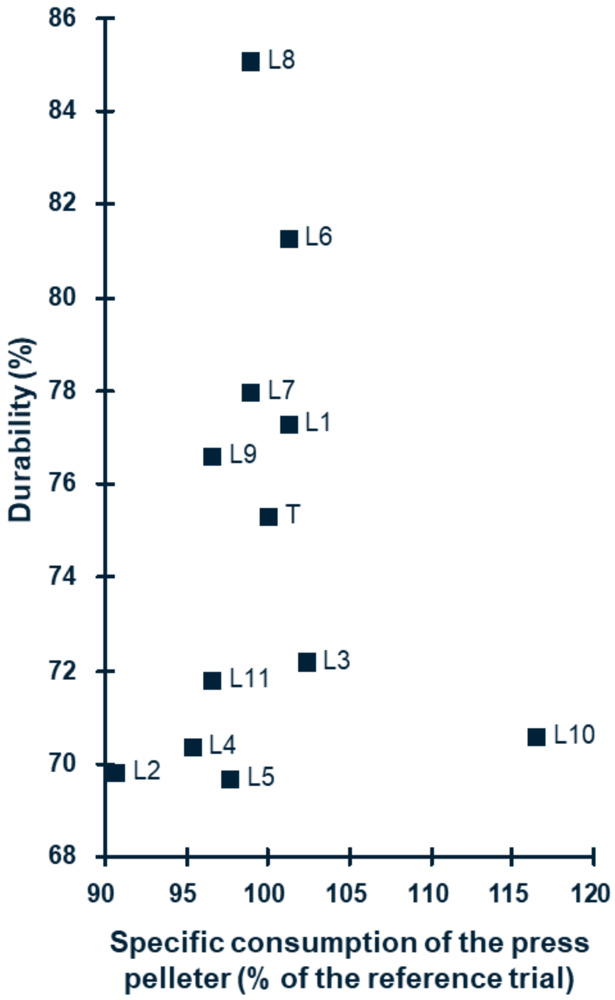

Figure 1: The influence of the type of binder

3.1. Testing campaign no. 1: Validation using an industrial press

The results of these tests confirm those observed in the pilot workshop.
Only lignosulfite (L8) has a statistically significant influence on the press's performance: an increase in durability, a reduction in specific consumption.
Binder L9 significantly improves the durability of pellets, while binder L2 increases the press's efficiency while reducing the durability of pellets (Table 3).

3.2. Testing campaign no. 2: The influence of the press's operation

In all cases, the increase in steam incorporation rates translates into a reduction in the press motor's specific consumption and an improvement in the cohesion of pellets (Figure 3).

The influence of press flowrate on the quality of pellets and on the press's efficiency is generally minor.

Treatment	Durability %	The press's specific consumption (kW/t)
L8-0.75 %	76.7 (c)*	16.25 (b)*
L9-3.0 %	75.6 (c)*	16.73 (c)*
L2-1.0 %	70.4 (a)*	15.66 (a)*
Control feed	73.1 (b)*	16.79 (c)*

* The values recorded with the same letter do not differ significantly.

Table 3: The influence of the type of binder - Testing campaign no. 1, plant tests

The incorporation of lignosulfite into the feed barely changes the press's specific consumption, but it still results in an improvement in the durability of pellets.
However, it is possible at a lower speed (7t/h), by increasing the meal's processing temperature, to achieve the same pellet quality with or without a binder (tests L7-74 and T7-74).
This increase in the processing temperature is accompanied by an increase in the specific consumption of heat energy of 17 kW/t and a reduction in the press motor's specific consumption of 1.5 kW/t.

4. Conclusions

The results of the tests conducted on 11 binders enable an effective binder for pelleting poultry feeds with a high fat content (>7.5% on entering the press) to be selected: **"lignosulfite"**.

They also confirm that steam incorporation rates have an overriding and positive influence on the cohesion of pellets and on the press's electrical efficiency.

Consequently, the incorporation of this type of binder should only be envisaged when the press's operation is optimised. In effect, an estimate reveals that the extra cost of using a larger quantity of steam is lower than that resulting from the use of a binder (2.5F and 20 F/t respectively).

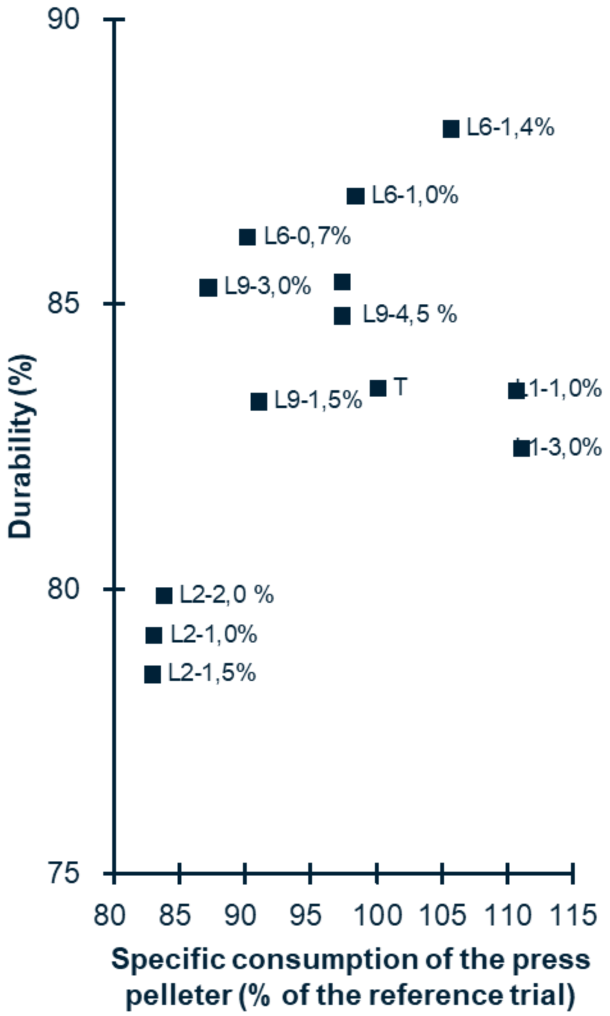

Figure 2: The influence of the level of binders

Key
Example:
L2-2.0%: Binder L2 incorporated at 2.0 %
T: Control feed without a binder

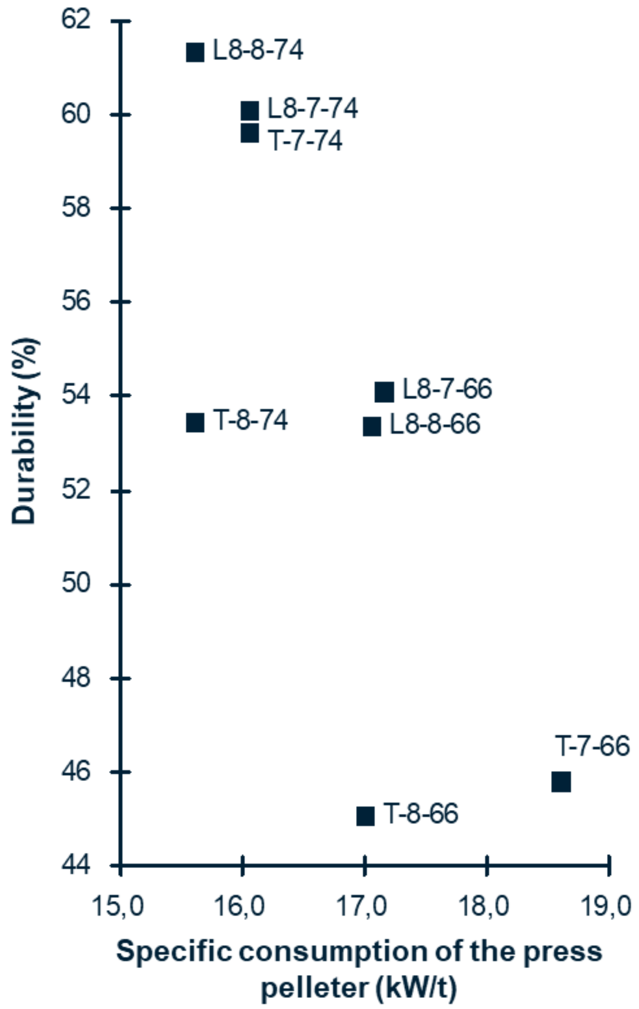

Figure 3: The influence of the press's operation (Plant tests)

Key
Examples:
L8-7-66: Binder L8 Lignosulfite, press speed 7 t/h, processing temperature 66°C
T-8-74: Control feed without a binder, press flowrate 8 t/h, processing temperature 74°C.

5. Bibliography

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