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A study on binding capacity of AquaTrac sol SD in pelletised aquaculture feed

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Abstract

The physical quality of shrimp feed pellets is primarily dependent on the binding efficiency of ingredients and to a certain extent on processing. According to the manufacturer, AquaTrac sol SD should have pellet binding properties.

An evaluation was carried-out by „The Waterbase Ltd.'s (TWL) Quality Control (QC) Department to check the binding capacity of AquaTrac sol SD. The test substance AquaTrac sol SD was included at the level of 2% (Group 2) and 5% (Group 3) in trial feeds and compared with TWL's Ultra 4PEP-XL as control group (Group 1) without test substance. Trial feeds were analysed by both the dry matter loss and the subjective water durability test in order to check the pellet stability. The tested groups showed statistically significant reduction ($P<0.05$) in dry matter loss by 11.9% (2.0%) and 19.3% (5.0%) in comparison with the control group.
At the same time, the subjective test for water durability also indicated a positive improvement with 8.1 points (2.0%) and 8.2 points (5.0%) in comparison with 8.0 points for the control group. Based on the trial results, it can be concluded that AquaTrac sol SD contributes to binding efficiency of pelletised feeds.

1. Introduction

Binders are substances used in diets to improve their pelletability, enhance durability, to preserve physical form during storage and to preserve the water stability.
There are at least three actions by which binders increase the hardness and water durability of pellets. Binders reduce the void space in the mix and thus provide a compact and durable pellet. Some binders possesses adhesive action where as other binders undergo changes during the pelletising process and exert a chemical action, which increases pellet durability (De-Silva and Anderson, 1995). The range of materials that have a pellet binding capacity is very wide and are classified as (Hertrampf and Pascual, 2000):

- Natural minerals
- Wood processing by-products
- Plant products with pellet binding properties
- Synthetic

Commonly used natural binders for shrimp feed pellets are wheat gluten, high gluten wheat flour, tapioca flour, rice gluten, maize starch, guargum, arabic gum, etc. (Hertrampf and Pascual 2000).

Synthetic polymers are also used to provide binding to the feed pellets (Akiyama et al., 1991). The most commonly used synthetic binder is polymethylol carbamide. As shrimp feed require greater binding properties, most research work on binders has been done on shrimp feeds (Dominy and Lee, 1991).
Another important quality criterion for shrimp feed pellet binding is the abrasiveness of pellets. A high abrasiveness forms the unwanted dust development, which particularly transpires during the transport of feed. In most cases, a low pelletising ability corresponds with high abrasiveness. The quality of pelleted feed may vary as the raw materials used vary (Hertrampf, 2001).
The objective of this trial is to test the binding capacity AquaTrac sol SD in pelletised shrimp feed. The trial was carried-out on behalf of GEPRO Geflügel-Protein Vertriebsgesellschaft mbH & Co.KG, Diepholz, Germany.

2. Material and Methods

Following materials were used:

- TWL pelletised feed (Ultra 4PEP-XL) produced as per trial formulation
- Mechanical stirrers (300 rpm) with timer
- Hot air oven (135°C)
- Beakers (250 ml)
- Petri dishes
- Weighing balance
- Desiccator
- Sieve (16 mesh)

The following three groups of TWL's semi intensive shrimp feeds (Ultra 4 PEP-XL) were produced as per the inclusion levels of test substance (HPPC) given below:

Group 1: Feed as per standard formulation and without wheat gluten (control group)
Group 2: Feed with inclusion of 2.0% AquaTrac sol SD and without wheat gluten.
Group 3: Feed with inclusion of 5.0% AquaTrac sol SD and without wheat gluten.

Twenty representative samples were drawn from each of the feeds produced as per above formulation. Both dry matter loss test and TWL's subjective water durability tests were carried out in triplicate. A comparative evaluation was made with the control group in order to know the binding capacity of AquaTrac sol SD.

2.1 Subjective water durability test:

Take 5 g of pelletised feed in a 250 ml beaker containing water subjected to intermittent disturbances (to simulate pond condition) using a mechanical stirrer with 300 rpm speed. The stirrer rotates for 20 sec. at an interval of five minutes.
When immersed in water, feed undergoes the following changes:

- Swelling
- Development of cracks (single or multiple)
- Fines falling apart
- Creation of turbidity
- Disintegration

Based on the degree of changes in each of the above parameters, the condition of pellets was checked by three chemists at the end of two and half hours testing time. The evaluation of feed pellets is made by using a rating chart comparing of points from 1 to 10. The higher the rating points the better is the water durability of pellets. TWL specification for accepting the pelletised shrimp feed is a minimum of 8.0 pts. The average rating of three chemists' evaluation is considered as the actual water durability (WD) points for that particular feed (Hertrampf and Farooq, 1999). The rated WD points for the trial feeds and control feed as per above system and calculated mean, standard deviation subjected to test of statistical significance (Kapur, 1982).

2.2 Dry matter loss test:

As per this method, pellet stability was determined by the amount of dry matter lost due to disintegration from pelletised feed at the end of two and half hours immersion in water (Boonyaratpalin, 1984).The method is slightly modified from that of prescribed method with regard to usage of slow stirrers instead of aerators to create disturbance (Farooq, 2000).
Accurately weighed quantities (about 5 g) of the feed pellets were taken in a beaker containing water. Created intermittent disturbance by slow stirrers (300 rpm speed), which rotate for

20 sec. at an interval of five minutes. After two and half hours of immersion time, the pellets were passed through a sieve and disintegrated fines were filtered off. Washed the pellets with water and transferred them to a pre-weighed petri dishes. Dried the pellets in a hot air oven at 135° C for three hours. Cooled in a desiccator and weighed. Analysed original moisture content of feeds for calculation of initial dry matter.

Calculation:

Dry matter loss [(100-(W2-W) / W1] x 100

Whereby

W1 = initial weight of pellets (dry basis)

W = weight of empty petri dish

W2 = weight of petri dish with dried material.

Analyses were carried-out in triplicate and average and standard deviation were calculated. All recorded data were statistically analysed.

3. Results and Discussion

The binding capacity of AquaTrac sol SD was evaluated by conducting tests for subjective water durability and dry matter loss in the trial feeds produced. Subjective water durability test is a visual observation and pellets are ranked according to disintegration, cracks, swelling etc. The second test assessed the dry matter loss from pelletised feed samples. Twenty samples were analysed from each trial group for dry matter loss and subjective WD rating respectively.

The mean values for dry mater loss for Group 1 (control), Group 2 (2.0% AquaTrac sol SD) and Group 3 (5.0% AquaTrac sol SD) are 20.2%, 17.8% and 16.3% respectively. The standard deviations are 0.33, 0.21 and 0.22 for Group 1, 2 and 3 respectively **(Table 1) (Figure 1)**.

The tested groups showed 11.9% (2.0% AquaTrac sol SD) and 19.3% (5.0% AquaTrac sol SD) statistically significant lower dry matter losses in comparison with control ($P<0.05$). The lower the disintegration, the better is the pellet stability and subsequently the better binding capacity. Since the processing conditions and ingredients are the same for all the tested groups, the enhancement of pellet stability in Group 2 and Group 3, in comparison to the control can be attributed to binding capacity of AquaTrac sol SD.

Although, the water durability of aquaculture feed is of most imminent importance, there is still no standardised method or a generally accepted procedure available for testing the water durability of pelleted aquaculture feed (Heidenrich, 2000). Keeping this in view, TWL has developed its own subjective method based on rating system (Hertrampf and Farooq, 1999) for judging water durability of pelletised shrimp feed. Although it is a subjective method, the obtained results are very satisfactory.

Dry matter loss test can be considered as the most objective procedure for evaluating the water durability. Dry matter loss test was developed by Boonyaratpalin (1984). In her trials, she measured the disintegration of pellets by weight loss in water after determined time. The weight loss in water is used as a parameter for the water durability. This type of test has been used in other research work (Anonymous, 1987; Pascual, 1990; Dominy and Lim, 1991).

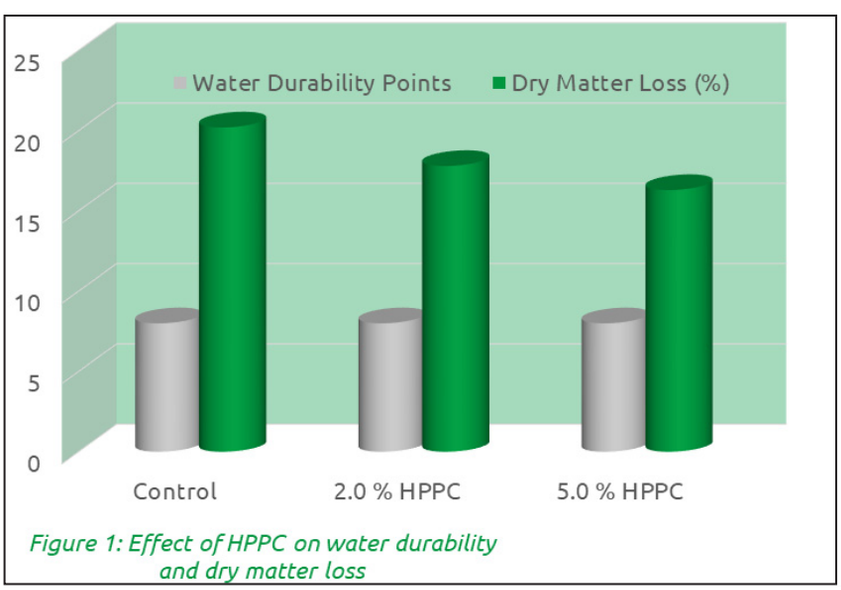

Figure 1: Effect of HPPC on water durability and dry matter loss

Although the results are promising, the procedure is very time consuming.

It has been shown by Boonyaratpalin (1984); Dominy and Lim, (1991) that the binders are beneficial in enhancing water stability under similar conditions of processing and the same feed ingredients. During the pelletising process, the form or structure of pellets may be created by the binder, the binder and the feed ingredients or feed ingredients alone. Since the present trial was a comparison of the control diet (no AquaTrac sol SD added) against binder treatments under the same processing condition the enhancement of the water stability can be attributed to the binding capacity of AquaTrac sol SD.

While comparing the water durability by the subjective method, treatment groups showed better water durability points with 8.1 (2.0% AquaTrac sol SD) and 8.2 (5.0% AquaTrac sol SD) in comparison with control (8.0 pts).

Even though the differences are not statistically significant, but these minor differences have larger impact on pellet stability. Since rating is given on various physical parameters such as cracks, swelling, disintegration, this method has got an immense importance in segregating low and high water stability feeds on commercial basis.

Even to increase water durability from 8.0 pts to 8.2 pts, it requires addition of substantial quantity of binders. This may explain the importance of water durability points of 0.1 and 0.2 in the treatment groups.

4. Conclusion

Under the conditions of this trial, it can be concluded that AquaTrac sol SD has a positive impact on enhancing water durability of the pelletised shrimp feed.

Table 1: Analysis data for water durability and dry matter loss test (n=20)

	Group 1		Group 2		Group 3	
Replicates	W/D[1] pts	% DL[2]	W/D[1] pts	% DL[2]	W/D[1] pts	% DL[2]
1	8.0	20.5	8.1	17.8	8.2	16.2
2	8.0	19.9	8.1	17.6	8.2	16.5
3	8.0	20.3	8.1	17.9	8.2	16.0
4	8.1	19.8	8.1	17.8	8.1	16.2
5	8.0	20.6	8.1	17.9	8.1	16.2
6	8.0	20.7	8.1	17.8	8.2	16.8
7	8.0	20.5	8.1	17.6	8.2	16.1
8	8.0	20.8	8.1	17.8	8.2	16.0
9	8.1	19.9	8.0	17.9	8.2	16.3
10	8.0	20.1	8.1	17.3	8.2	16.5
11	8.0	20.2	8.1	18.0	8.2	16.4
12	8.0	19.8	8.1	17.6	8.2	16.1
13	8.0	20.4	8.0	17.9	8.2	16.2
14	8.1	19.7	8.1	18.1	8.2	16.4
15	8.0	20.3	8.1	17.6	8.1	16.3
16	8.0	20.6	8.1	17.4	8.2	16.2
17	8.0	20.0	8.1	17.9	8.2	16.7
18	8.1	19.9	8.1	17.6	8.1	16.4
19	8.0	20.2	8.0	18.0	8.2	16.6
20	8.1	20.5	8.0	17.9	8.2	16.5
Mean	8.0	20.2a	8.1	17.8b	8.2	16.3c
SD	0.04	0.33	0.04	0.21	0.04	0.22

[1] Water durability, points [2] Dry matter los

Different letters in the superscript denote significant difference between means (5% level)

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