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The Effect of Moisture with Organic Acids-Surfactant Milling Aid on the Feed Process and Quality of Pelletized Feed

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Abstract: During the animal feed production process, it inevitably loses water due to the high temperature applied in the production process. Feed manufactures have the objective to attain a maximum level of moisture in the feed without encouraging mold growth. Admixing moisture with organic acid-surfactant milling aid can guarantee a constant water level in feeds without harming the microbiological quality of the feed. A feed production trial was conducted to study the effect of introducing a milling aid and milling solution comprised of water mixed with organic acids-surfactant milling aid on the process and quality of pelletized broiler feed. The studied organic acids-surfactant milling aid (MNL) is synergistic blend containing ~54% of mixed organic acids and their salts with 1.95% of ethoxylated castor oil surfactant. The treatments: C0: no moisture and no organic acids-surfactant milling aid; T1: no moisture and NML at 1.0kg/T and T2: 1% moisture and MNL at 1.0kg/T were added to corn-soy based broiler diet at the mixer as top-dressing addition and diets were processed at a feed milling facility. Pellets were then evaluated according to feed manufacturing variables and pellet quality. Admixing organic acid-surfactant milling aid and/or with moisture resulted in an improvement in the pellet quality (starch gelatinization, pellet durability, moisture retention), feed mill parameters (feed production, energy consumption) and no deteriorate effect in mold inhibition compared to control. These results also demonstrated that T2 treatment group improved the overall pellet quality and feed mill parameters to much extent due to the better water holding capacity of feed moistened with milling solution attributed by the presence of surfactant in the organic acid-surfactant milling aid to potentiate the water binding during the preconditioning process.

Keywords: Animal Feed Manufacture, Pellet Quality, Organic Acids, Efficiency and Moisture

1. Introduction

Water is an important component of raw feed material and animal feed. In animal production water is an essential nutrient and the feed needs to contain a certain moisture content for the animal to have an optimum feed intake and digestion. Managing moisture during feed processing is critical since moisture loss takes place at several steps of the production process. During the feed production, grinding and cooling are the two main processes whereby loss of moisture occurs, with ~0.5%-1.5% of the moisture loss observed. These losses need to get compensated before feed packaging to maximize final output and profit. Proper moisture management leads to the production of stable pellets that provide a stable source of nutrition when consumed by the animal [1-4]. A common solution to compensate moisture loss is the addition of water in the form of steam during conditioning [1]. The addition of steam aids to gelatinization, which plays an important role in throughput at the pelletizer press [5]. However, the increased levels of moisture also pose a risk for mold growth [6]. When not implemented correctly, moisture management can even negatively impact feed quality as it can result nutrient dilution, while microbial growth and mycotoxins can pose a risk to animal health and performance. To combat the problem of mold contamination, commercial mold inhibitors have been used [7, 8]. Typically, these substances contained organic acids and surfactant that are able to improve the water holding capacities of the feed and give an extra protection against mold growth.

The objective of this study was to determine the effect of introducing an organic acids-surfactant milling aid (MNL) [9] and milling solution comprised of water mixed with organic acids-surfactant milling aid into the mixing process to improve the wetting and absorptive properties of the feed and on the feed process and quality of pelletized feed.

2. Materials and Methods

2.1. Trial Set up

All broiler finisher diets were produced by a feed mill. The feed production trial consisted of 2 treatments groups and one control group (Table 1). Feed processing was carried out in the facility and the treated and control feeds were monitored for milling efficiency and analyzed for feed quality. The pelleting trial includes conditioning using saturated steam at a process temperature of 85°C. Pellets were produced using a ring-die press. All batches were performed in triplicates under similar controlled conditions. Measurement and sampling only started when the system was under constant conditions and thermal equilibrium was reached.

Table 1. *Details of treatment conducted in the trial.*

Treatment	Treatment details
C0	3 batches x 500kg batch size of broiler feed with no moisture and no MNL
T1	3 batches x 500kg batch size of broiler feed without moisture and MNL at 0.1%
T2	3 batches x 500kg batch size of broiler feed with milling solution (1% moisture and NML at 0.1%)

MNL contained is synergistic blend containing ~54% of mixed organic acids and their salts with 1.95% of ethoxylated castor oil surfactant.

Throughout manufacture, production rate and pellet mill energy consumption were monitored. Immediately following manufacture, pellets were sampled and analyzed to determine the moisture loss during production, mold counts over 8 weeks storage, pellet durability index (PDI) and starch gelatinization. All samples were analyzed in triplicates, with the averages providing a mean for each replicate.

2.2. Measurements and Analytical Methods

Moisture content of the feed samples was analyzed using hot air oven method [10] and water activity was determined by obtaining the reading directly from AquaLab Water Activity Meter respectively. Mold count [10] expressed as cfu/g sample was tested on the feed after 8 weeks storage. Starch gelatinization was determined using Perkin Elmer DSC-7 [11]. Pellet durability index (PDI) was measured on feed sample by tumbling 500g of sieved sample for 10 min at 50 rpm, in a tumbling box device scribed [12].

2.3. Statistical Analysis

Significant differences among treatment groups were tested by one-way analysis of variance (ANOVA) and the comparison of any values was made by Duncan's multiple range tests. A significance level of $p<0.05$ was used. The statistical analysis was performed by statgraphics 5.1.

3. Results and Discussion

3.1. Moisture Retention, Water Activity and Shelf-Life

All the parameters evaluated in this trial for control and treatment groups are presented in Table 2.

Table 2. *Treatment effects on milling parameters and pellet quality.*

Moisture along the process line			
	C0	T1	T2
After mixer	9.27^{a}	9.48^{b}	10.29^{c}
After conditioning	12.69^{a}	13.19^{b}	14.13^{c}
After pelleting	12.33^{a}	13.07^{b}	13.99^{c}
After cooler	9.76^{a}	10.39^{b}	11.08^{c}
Moisture Recovery	-	63%	132%
Mill efficiency parameters			
Pellet output (kg/hr)	773.54^{a}	807.12^{b}	830.24^{c}
Energy consumption (kwh/mt pellets)	9.67^{a}	9.21^{b}	8.67^{c}
Pellet quality			
PDI (%)	76.86^{a}	79.00^{b}	79.32^{b}
Water Activity (a_w)	0.67^{a}	0.67^{a}	0.70^{b}
Starch gelatinization (%)	23.04^{a}	23.71^{a}	23.84^{a}
*Mold count $\log_{10}$ (cfu/g)	5.72	4.38	4.59

a, b, c, Means within row with no common superscript differ significantly (P<0.05). *measured after 8 weeks storage.

With the inclusion of the organic acids-surfactant milling aid (T1) and milling solution comprised of water mixed with organic acids-surfactant milling aid (T2) it improved the production yield by locking up to 63-132% more moisture in finished feed compared to untreated feed (C0). This effect can be explained by the water binding and surfactant property not only hold the added water but also capture part of the steam that was injected during the pelleting process. The moisture content in the feed, determined the yield and confirmed the end point of dry weight. The shelf stability associated with the loss of water content is influenced by the water activity (a_w). Treated feed (T2) supplemented with the milling solution possessed a higher a_w compared with other treatments. A possible explanation is that the addition of water in the experimental diets had increased the amount of free moisture, evident from the outcome on water activity (Table 2). This free water was driven off more efficiently from the pellet feed. Surface tension of free water was expected to be firmly bounded in the feedstuff granules in diets supplemented with surfactant which minimized the water migration and increased the water retention in feed particle. In addition, treated feed (T2) did not show increased mold growth after 8 weeks storage despite having higher moisture and water activity (> 0.67) due to the mixed organic acids and their salts present in milling aid to protect the feed from microbial degradation.

3.2. Pellet Output and Energy Consumption

As shown in Table 2, the increased moisture levels significantly reduced the energy usage of the pelleting process, in kg per hour as well as in kwh per metric ton of feed produced. The reduction was more for treatment groups (T1 and T2), both reducing energy consumption by 4.8 and 10.3%, respectively. This result confirms that higher moisture levels have positive effects on reducing the energy cost of feed production. As an additional benefit, production runs more smoothly, lowering the risks of blockages during the pelleting process and indirectly raising the feed output by 4.3 and 7.3% compared to control.

3.3. Starch Gelatinization and Pellet Durability

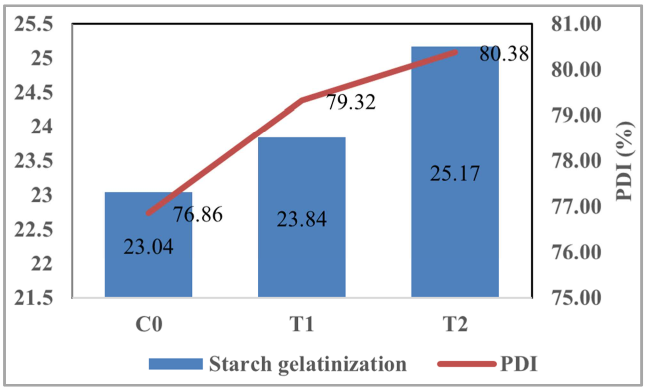

Figure 1. *Starch gelatinization and pellet durability index of control and treated feed.*

Figure 1 shows the effect of milling aid and milling solution on the starch gelatinization of the pelleted feeds. Starch gelatinization improved numerically after the conditioning process with higher gelatinization of starch obtained in treatment T2 (milling solution comprised of water mixed with organic acids-surfactant milling aid). Past studies have correlated increasing moisture content of feed with an increase in starch gelatinization [13-15]. This effect can be explained by the water binding and surfactant properties to allow better steam penetrating into the meal granules. Such effect reflected in a better "cooked starch" in the feed treated with milling aid and milling solution. Increase in starch gelatinization have also been linked to improvements in PDI [2, 13-15] and such effect was observed in both treated group T1 and T2 where PDI was improved by 2.7 and 3.2%, respectively. The use of water and milling aid resulted in better starch gumming effect, which functions as an adhesive in pellet binding, thus aiding in durable pellet formation.

4. Conclusion

From this study, it showed that an organic acids-surfactant milling aid or milling solution comprised of water mixed with organic acids-surfactant milling aid to a corn-soy based broiler diet has no deteriorating effect in the quality and safety of the pellet feed. Significant differences showed in moisture content, water activity and shelf-life has provided valuable information on the effect of water and organic acids-surfactant milling aid to the gelatinization of starch, which contributed to the physical properties of the pellet feed. In addition, the increased moisture levels showed reduced energy usage of the pelleting process, improved the feed output while maintaining shelf-life of the feed compared to control. It is concluded that the effect of the organic acids-surfactant milling aid or milling solution comprised of water mixed with organic acids-surfactant milling aid in economic savings was found in this specific experimental design.

References

[1] Fairfield, D. A. (2003). Pelleting for profit—part 1. National Grain and Feed Association Feed and Feeding Digest, 54 (6): 1-5.

[2] Briggs et. al. (2009). Effect of ingredients and processing parameters on pellet quality. Poult. Sci. 78: 1464–1471.

[3] Fairchild, F. & Greer, D. (1999). Pelleting with precise mixer moisture control. Feed Int. 20 (8): 32-36.

[4] Moritz, J. S et al. (2003). Feed manufacture and feeding of rations with graded levels of added moisture formulated at different densities. J. Appl. Pout. Res. 12: 371-381.

[5] Lund, D. (1984). Influence of time, temperature, moisture, ingredients and processing conditions on starch gelatinization, CRC Crit. Rev. Food Sci. Nutr. 20: 249-273.

[6] Rahnema, S. & Neal, S. M. (1992). Preservation and use of chemically treated high-moisture corn by weanling pigs. J. Prod. Agric. 5 (4): 458-461.

[7] Tabib, Z., Jones, F. & Hamilton, P. B. (1984). Effect of pelleting poultry feed on the activity of molds and mold inhibitors. Poult Sci. 63: 70-75.

[8] Hott et. al. (2008). The Effect of Moisture Addition with a Mold Inhibitor on Pellet Quality, Feed Manufacture, and Broiler Performance. *J. Appl. Poult. Res.* 17: 262–271.

[9] Chow, E. P. Y. (2021). The use of organic acids in managing microbial degradation and preserving feed quality. Feed Additives (https://www.feedandadditive.com/the-use-of-organic-acids-in-managing-microbial-degradation-and-preserving-feed-quality/).

[10] Association of Official Analytical Chemists (AOAC). (2005) 18th ed. Washington: Official methods of Analysis.

[11] Vanna, T., et al. (2006). Determination of Starch Gelatinization Temperatures by Means of Polarized Light Intensity Detection. J. Sci. Res. Chula. Univ., Vol. 31, 13-23.

[12] American Society of Agricultural Engineers (ASAE). (1998) Cubes, pellets, and crumbles: definitions and methods for determining density, durability, and moisture content [S269]. St Joseph.

[13] Moritz, J. et al. (2001). Effect of moisture addition at the mixer to a corn-soybean-based diet on broiler performance. J. Appl. Poult. Res. 10: 347–353.

[14] Moritz, J. et al. (2002). Effect of formulation density, moisture, and surfactant on feed manufacturing, pellet quality, and broiler performance. J. Appl. Poult. Res. 11: 155–163.

[15] Thomas, M. et al. (1998). Physical quality of pelleted animal feed 3. Contribution of feedstuff components. Anim. Feed Sci. Technol. 70: 59–78.