Effect of Corn Moisture on the Quality of Poultry Feed

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Abstract
Moisture is an important factor of a raw material for producing poultry feed. Around 60% corn is used in poultry feed as a feed ingredient. So it is recognized that, corn is the main ingredients of poultry feed. Feed moisture or feed quality is directly related to the corn moisture. In this investigation three different moisture levels (14%, 15% and 16%) in corn have been used in feed. Among these three types, corn with 14% moisture can be used in both pellet and mash feed by storing less than one month. In this case the quality, particle size and physical appearance of feed were quiet normal. Corn with 15% moisture can be used directly only in pellet feed, but corn with 16% moisture can not be used. Because this high moisture corn the outcome feed moisture is affected and the quality is also degraded and thus the feed can not be stored for a long time. So, to adhere the quality of feed, corn with 15% moisture can be used directly without storing but corn with 16% moisture must have to dry before use.

Keywords: Corn, Moisture, Poultry feed, Particle size, Quality, Pellet feed, Mash feed.

1. Introduction
Corn is one of the oldest crops in the world. It is a major food in the Central and South African countries end in parts of India, Pakistan, Nepal, Thailand, China, Philippines, Japan and Turkey. In Bangladesh it is used mainly as a snack and rarely known as an item of main meal.

Corn has been a known crop in Bangladesh for a long time. It was probably introduced in India by the Portuguese in the mid-16th century. But efforts to develop new corn varieties or to expand or popularize the use of corn as food grain or for industrial products began in the mid-1940s when the Imperial Council of Agricultural Research imported corn germplasm from the United States and initiated research on development of hybrid corn varieties suitable for local conditions. However the work concentrated mainly on sweet corn and popcorn varieties and was soon discontinued. In 1960 the government of East Pakistan tried to popularize corn by ordering corn to be grown one very vacant piece of land. Then in early 1960s, the short high yielding wheat and rice varieties were introduced from CIMMYT and IRRI. Agricultural research and promotional efforts focused on this crop and corn was forgotten.

Research on corn was stimulated by the establishment of the Bangladesh Agricultural Research Institute (BARI) in 1976 initially with a Ford Foundation Grant. In the early 1980s under the BARI program several studies were conducted on agronomic and socio-economic aspects of corn production. Corn promotion received further momentum when USAID signed an agreement with the government of Bangladesh in 1987 under PL480 title II in which it has been agreed to mount campaign to introduce a new self-targeting grain, corn, into the country's public food distribution system. The unprecedented flood of 1987 and 1988 in Bangladesh provided additional opportunity to promote corn. USAID provided 250 mt. of corn seed in 1987 and UNDP provided 50 mt. of corn seed in 1988 for distribution to selected corn growers in the country under the country's post flood agricultural rehabilitation program. In 1985 another development took place. Bangladesh government constituted a taskforce for the development of corn research and cultivation in Bangladesh. The Department of Agricultural Extension then launched a corn production program in the 1987 kharif season as a result of the taskforce recommendations to produce corn in 1000 acres in 20 districts and demonstrate and train farmers in corn production. In 1988 the taskforce on corn developed the proposal for an integrated corn development project which led to the current efforts to expand corn cultivation in Bangladesh.
Corn is generally regarded as an inferior food and therefore food for the poor and food during famine in Bangladesh. If corn is introduced in large quantities in the food market, at cheaper than rice and wheat price, poor people would be more attracted to buy it and the level of consumption of food and nutrients of the poor would increase. Thus corn can be an important means to attain food self-sufficiency crop to reduce food gap of the poor and the country. It has high potential to produce feed, food, fuel and industrial raw material. Given appropriate support it can emerge as the third most important crop after rice and wheat. Should the crop occupy large areas in the marginal farmers' fields it can also become a major source of income for the poor.

Bangladesh is an agricultural and developing country. Now a day’s agribusiness is growing up very fast in Bangladesh. A number of national and multinational companies have been established in Bangladesh and they are producing poultry feed (Islam et al., 2015a) by using local raw materials. Corn is one of the important local raw materials (Islam et al., 2015b; Bao et al., 2011; Shukla and Cheryan, 2001). Corn is the third most important cereal after rice and wheat in our country. Corn is used as main ingredient (35-50%) in poultry feed (Marc et al., 2002; Sun et al., 2012). Corn moisture content is related with storage time and feed quality (Liu et al., 2013; McClements, 2007).

2. Materials and Method

2.1 Collection of Corn
Corn with three different moisture content (14%, 15% and 16%) was collected from local farmer at Rajshahi Division for comparable research. After collection the actual moisture of the three different specimens were checked out in the laboratory by moisture tester (EE-KU) machine (Islam et al., 2015a). Detailed information of the collected corn (Actual moisture of the corn) are represented in the Table 1. The collected corn was kept on the floor plate separately in a safety and well ventilated godown. Temperature, humidity and pest control were the important factor that was carefully handles to maintain the research findings. For storing the corn specimen (Shamsudeen et al., 2013; Mader and Erickson, 2006; Mahanna, 2007), gunny bags were used, so that air can easily pass throughout the bag. Storing corn was properly labeled by mentioning moisture and date for avoiding further any confusion. Storing of the three different specimens is represented in the Fig 1.

2.2 Grinding of Collected Corn
The collected corn were ground by grinding machine using (6.0 x 8.0) mm net size with 1500 rpm speed of hammer motor. Particle size of the grinding corn was measured by standard sieving net and was compared to the standard grinding particle size. Grinding particles of the different specimen are represented in the Table 2. Grinding particles and physical appearance of the different specimen are represented in the Table 2. The grinding particles and physical appearance of the different specimen were found to be normal for further feed production (Benton et al., 2004; Cooper et al., 2002). The grinding materials were kept separately with proper label on the floor plate for checking the different parameter of corn after seven days interval within a month (Defoor et al., 2000; Prigge, 1976). Physical appearance of the -
2.3 Production of Feed by Using Three Different Corn

Feeds (Mash and Pellet Feed) were produced separately by using three different corn specimens and were kept very carefully in separate gunny bags on floor plate for checking different parameters after seven days interval within a month. During production of both feed, standard formulation and feed producing parameters were maintained same as other normal feed as usual. Other raw materials were previously ground by the standard procedure as the requirements of the finished goods (Young et al., 1982; Owens and Secrist, 1994). Mash feed and pellet feed particle size were measured by standard sieving net and were compared to the standard to maintain the quality of feed (Van Koeveering et al., 1994). Physical appearance of the mash feed and pellet feed are represented in the Fig 3. In the feed formulation, corn has been used about 35% of total raw materials. Some other raw materials were soybean meal, meat and bone meal, rice bran fine, mustard meal etc. feed produced by different corn item were kept separately with proper tag on different floor plate for easy identification and evaluation of the research findings. As the moisture is an important factor (Briggs et al., 1999; Behnke, 1998; Mommerand Ballantyne, 1991), the produced feed were kept very much carefully to protect any type of contamination.
and emulation.

3. Results and Discussion

Different parameter of both mash feed and pellet feed for three separated corn item were compared carefully with the standard to evaluate the actual findings or output of the project research. Particle size of corn and finished goods are represented in the different table. Grinding corn moisture along with other nutrient values were estimated to compare and ensure the quality of finished goods. Effects of corn moisture on the finished product within a month were observed.

3.1 Grinding Corn Particle

Physical appearance and particle size of grinding raw material were check out to compare with the standard parameters. Grinding corn particles are found to be normal and are identical with the standards which are represented in Table 2. Percent fine is also reasonable in amount. Moisture fluctuations of grinding corn with time duration are represented in the Fig 4.

3.2 Mash Feed Particle

Mash feed particle was found normal and also identical with the standard particle size. During mixing of other raw materials, all parameters were same as other feed production. For particle size measurement, standard sieve (Seven pieces) was used and percentage fine of feed was within the standard. Particle sizes are represented in the Table 3.

3.3 Feed Processing Parameter

Feed processing parameters were same as other standard feed during producing our research feed. Different processing parameters are represented in the Table 4. For about 16%, moisture has been observed over standard. Normally 12% moisture in feed is allowed by QC.

3.4 Pellet Feed Particle

Particle size of pellet feed was measured by standard size of sieving net. There is no significant change of particle size of the different items of feed. Particle size data are represented in the Table 5. Pellet feed moisture also observed with time; some fluctuations are observed due to the environment condition. Moisture content of pellet feed with time is
Islam et al. 2015. 

**Table 3: Mash feed particle size**

<table>
<thead>
<tr>
<th>Research Item</th>
<th>RPM</th>
<th>Knife</th>
<th>Net Feed Particle Size (% ON 0.7 ON 0.5 PASS 0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%M-14</td>
<td>1500</td>
<td>64</td>
<td>6.0 X 8.0 1.11</td>
</tr>
<tr>
<td>%M-15</td>
<td>1500</td>
<td>64</td>
<td>6.0 X 8.0 1.39</td>
</tr>
<tr>
<td>%M-16</td>
<td>1500</td>
<td>64</td>
<td>6.0 X 8.0 1.53</td>
</tr>
</tbody>
</table>

**Table 4: Feed processing parameters**

<table>
<thead>
<tr>
<th>Item</th>
<th>Set Disp. Mixer Hot Cond.</th>
<th>Hot Pelt.</th>
<th>Cool Temp</th>
<th>Fine Pressure Die Pack % (Bar) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%M-14</td>
<td>84.0 83.0 36.0</td>
<td>79.0 82.0</td>
<td>34.0 33.0</td>
<td>12.8 13.9 16.2 11.7 5.47 2.00 3.50</td>
</tr>
<tr>
<td>%M-15</td>
<td>84.0 83.0 34.0</td>
<td>80.0 81.0</td>
<td>35.0 35.0</td>
<td>13.5 14.5 13.4 12.8 5.71 2.00 3.50</td>
</tr>
<tr>
<td>%M-16</td>
<td>84.0 82.0 34.0</td>
<td>79.0 82.0</td>
<td>34.0 34.0</td>
<td>13.8 14.7 13.7 13.2 5.59 2.00 3.50</td>
</tr>
</tbody>
</table>

**Table 5: Pellet feed particle size**

<table>
<thead>
<tr>
<th>Research Item</th>
<th>RPM</th>
<th>Knife</th>
<th>Net Feed Particle Size (% ON 0.7 ON 0.5 PASS 0.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%M-14</td>
<td>1500</td>
<td>64</td>
<td>6.0 X 8.0 3.50</td>
</tr>
<tr>
<td>%M-15</td>
<td>1500</td>
<td>64</td>
<td>6.0 X 8.0 3.77</td>
</tr>
<tr>
<td>%M-16</td>
<td>1500</td>
<td>64</td>
<td>6.0 X 8.0 3.50</td>
</tr>
</tbody>
</table>

**Table 6: Finished feed analysis data**

<table>
<thead>
<tr>
<th>Research Item</th>
<th>% Moisture</th>
<th>EE-KU</th>
<th>OVEN</th>
<th>% CP</th>
<th>% Ca</th>
<th>Temp./C</th>
<th>Physical</th>
<th>Smell</th>
</tr>
</thead>
<tbody>
<tr>
<td>%M-14</td>
<td>14%</td>
<td>11.5</td>
<td>11.7</td>
<td>10.28</td>
<td>10.00</td>
<td>20.89</td>
<td>0.983</td>
<td>Normal</td>
</tr>
<tr>
<td>%M-15</td>
<td>15%</td>
<td>12.6</td>
<td>12.7</td>
<td>11.16</td>
<td>11.35</td>
<td>20.78</td>
<td>0.778</td>
<td>34.5</td>
</tr>
<tr>
<td>%M-16</td>
<td>16%</td>
<td>13.2</td>
<td>13.1</td>
<td>12.04</td>
<td>12.12</td>
<td>19.92</td>
<td>0.758</td>
<td>34.3</td>
</tr>
</tbody>
</table>

**Table 7: Physical check-up of finish goods**

<table>
<thead>
<tr>
<th>Condition</th>
<th>After 0 days</th>
<th>After 7 days</th>
<th>After 14 days</th>
<th>After 21 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>14%</td>
<td>15%</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>Smell</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
| Temperature | 31.5       | 31.2         | 31.1          | 31.0          | 32.5         | 30.7          | 30.9 | 32.9 | 30.5          | 30.7 | 32.7 | Note: N= Normal condition; Different= Significant notification

represented in the Fig 5. For about 16%, moisture stands over the standard (Std. 12% max.).

**3.5 Analysis of Pellet Feed**

Oven moisture along with other nutrients was measured to compare with the standard data (Islam et al., 2015a). All other nutrients are found to be normal except moisture of the feed produced by the corn with 16% moisture. For about 16%, percentage of crude protein and percentage of calcium are also observed. Analysis data of nutrient values are represented in the Table 6.
From Table 6, the analysis data is normal for about 14% and 15% research item. But, for about the 16% research item, the value of crude protein and calcium has been deviated from other two items or normal value. The moisture content (Fairchild and Greer, 1999; Benton et al., 2005) of feed which is the important factor has also passed the tolerance limit. Over content moisture cannot be passed by quality control and also it creates a great problem during storing of feed.

3.6 Physical Check-up of Pellet Feed
The feed quality is not only dependant on the nutrient values but also depends on some other parameters, like as physical appearance, smell, temperature etc. these parameters can be degraded with time due to the raw materials quality. If raw materials properly used then the feed quality will remain constant up to two months. We have observed our producing feed within a month (Owens et al., 1997; Stock et al., 1991). After that, we felt an abnormality in terms of smell of feed produced by corn with 16% moisture. Other feed were quiet normal as like as standard feed. Physical data are represented in the Table 7.

4. Conclusion
According to the weather condition of Bangladesh, huge amount of corn is produced during
the cultivation period, but due to the drying and storing problem, both farmer and feed producing companies face a problem for handling the high moisture corn. Most of the feed producing companies buy maximum 12-13% moisture content of corn for storing and using in their feed. So our research trend was to find out a way to manage the high moisture corn. After 21 days continuous observation of this research, we can conclude some assumptions are as follows:

1. Corn with 14% moisture content can be used in both pellet feed and mash feed without any problem and also one can store this corn for about one week without any difficulties.
2. Corn with 15% moisture content can be used only in pellet feed, but have to be careful the final moisture of finish feed.

5. Acknowledgement

We are very much grateful to the polymer and pharmaceutical research laboratory of the Department of Applied Chemistry and Chemical Engineering, Rajshahi University, Central Science Laboratory of Rajshahi University and Research Laboratory of Poultry Feed Factory, Rajshahi, Bangladesh for assisting to achieve the goal of this study. We are also grateful to the teachers and some research students of the Department of Applied Chemistry and Chemical Engineering, Rajshahi University.

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