IV. RESULTS

The results of the *in vitro* trial for screening of non-starch polysaccharides of sunflower meal (SFM), deoiled rice bran (DORB) and the compounded diets and the *in vivo* trials on the effect of inclusion of SFM and DORB with enzyme supplementation A or B to layer diets in the second phase of production on performance viz egg production, egg weight, feed intake, feed efficiency, livability, intestinal viscosity and litter moisture are presented in this chapter.

4.1 *In vitro trial*

4.1.1 Screening of nonstarch polysaccharides (NSP)

The total pentosan, pectin, cellulose, soluble and total NSP contents of ingredients and the compounded diets quantified in this study are presented in Table 9.

Table 9. Total pentosan, pectin, cellulose and total NSP content of ingredients and the compounded diets.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Total pentosan %</th>
<th>Pectin %</th>
<th>Cellulose %</th>
<th>Total NSPs %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>5.34</td>
<td>1.03</td>
<td>3.16</td>
<td>9.37</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>4.23</td>
<td>5.93</td>
<td>5.82</td>
<td>28.54</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>11.12</td>
<td>4.91</td>
<td>23.52</td>
<td>39.61</td>
</tr>
<tr>
<td>Deoiled rice bran</td>
<td>10.56</td>
<td>6.12</td>
<td>15.38</td>
<td>41.23</td>
</tr>
<tr>
<td>Diet-1</td>
<td>5.72</td>
<td>2.15</td>
<td>5.98</td>
<td>15.77</td>
</tr>
<tr>
<td>Diet-2</td>
<td>6.30</td>
<td>2.09</td>
<td>7.21</td>
<td>16.95</td>
</tr>
<tr>
<td>Diet-3</td>
<td>6.87</td>
<td>2.07</td>
<td>8.45</td>
<td>18.14</td>
</tr>
<tr>
<td>Diet-4</td>
<td>7.44</td>
<td>2.04</td>
<td>9.69</td>
<td>19.32</td>
</tr>
</tbody>
</table>

(Values are mean of triplicate analysis)
4.1.1.1 Total pentosan

The average total pentosan percentage values were 5.34, 4.23, 11.12 and 10.56 for ingredients maize, soybean meal, SFM and DORB and 5.72, 6.30, 6.87 and 7.44 for compounded diets 1 to 4, respectively. The increasing trend of pentosan in the diets 1 to 4 is the reflection of the high pentosan contents of SFM and DORB as their inclusion rates are increased in diets.

4.1.1.2 Pectin content

The average pectin percentages were 1.03, 5.93, 4.91 and 6.12 for maize, soybean meal, SFM and DORB and 2.15, 2.09, 2.07 and 2.04 for the diets 1 to 4, respectively. The decreasing levels of pectin in the diets are due to low pectin content of SFM and DORB put together when compared to soybean meal.

4.1.1.3 Cellulose content

The cellulose percentage values were 3.16, 5.82, 23.52 and 15.38 for maize, soybean meal, SFM and DORB and for the diets 1 to 4 were 5.98, 7.21, 8.45 and 9.69, respectively. SFM has the highest cellulose percentage of 23.52 followed by DORB having 15.38 percentages. The increasing cellulose content of the diets 1 to 4 is represented by the increasing inclusions of SFM and DORB in them.

4.1.1.4 Total NSP content

The total NSP percentages of maize, soybean meal, SFM and DORB were 9.37, 28.54, 39.61 and 41.23 and the diets 1 to 4 recorded 15.77, 16.95, 18.14 and 19.32, respectively. The increasing trend of total NSPs in the diet is due to the higher inclusions of SFM and DORB which have higher total NSP contents when compared to the ingredients maize and soybean meal.
4.1.2 Enzyme activities

Analyzed activities of xylanase, pectinase, cellulose, phytase and amylase for enzyme preparations A and B are presented in Table 10.

<table>
<thead>
<tr>
<th>Enzyme U/g</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylanase</td>
<td>1922</td>
<td>410</td>
</tr>
<tr>
<td>Pectinase</td>
<td>356</td>
<td>841</td>
</tr>
<tr>
<td>Cellulase</td>
<td>342</td>
<td>438</td>
</tr>
<tr>
<td>Phytase</td>
<td>264</td>
<td>48</td>
</tr>
<tr>
<td>Amylase</td>
<td>-</td>
<td>486</td>
</tr>
</tbody>
</table>

4.2 Biological Trials

The results of the biological experiment to study the effect of inclusion of SFM and DORB with enzyme supplementation A or B in layer diets on hen-day production, egg weight, feed intake, feed efficiency, intestinal viscosity, litter moisture, mortality and relative economics are presented hereunder.

4.2.1 Hen-day egg production

Data on average hen-day production percentage of laying hens fed 10, 15, 20 and 25 per cent each of SFM and DORB with and without enzyme A and B during the six periods and their mean values are presented in Table 11 with graphical representation in Fig. 4.

The analysis of variance (Table 11a) on hen-day production revealed that birds fed with SFM and DORB (10, 15, 20 and 25%) without enzymes show significant (P<0.05) difference in egg production. The highest egg production without enzyme supplementation was observed in 10 per cent SFM and DORB diet (89.93%) where as the lowest egg production was recorded in the 25 per cent SFM and DORB diets (88.47%). It was observed that the rate of egg production
was in decreasing order as the level of SFM and DORB in the diets increased (89.93, 89.31, 88.94 and 88.47%). The reduction in hen-day production at 15, 20 and 25 per cent SFM and DORB groups were 0.62, 1.0 and 1.4% as compared to 10% SFM and DORB enzyme non-supplemented groups.

The analysis of variance also revealed that the hen-day production on addition of enzyme A or B to SFM and DORB did not differ significantly between dietary treatment groups when compared with their respective controls without enzymes. But, the hen-day production was numerically greater in all the groups fed enzyme B followed by enzyme A as compared to their respective non-enzyme controls. The numerical increase in hen-day production at 10, 15, 20, 25 % SFM and DORB with enzyme A addition was 0.37, 0.22, 0.30 and 0.32% and with enzyme B addition was 1.29, 1.07, 0.99 and 0.92 when compared with their respective controls.

As the age of the laying hens advanced, there was a decreasing trend of egg production from period 1 to period 6 as well as in the mean of all the levels of SFM and DORB based diets with and without enzyme A or B supplementation during the experimental period.

4.2.2 Egg weight

Data on the average daily egg weight of laying hens fed with 10, 15, 20 and 25% SFM and DORB based diets with and without enzyme supplementation during the 6 periods and their mean values are presented in Table 12 and graphical representation in Fig. 5.

It is apparent from the analysis of variance Table 12a that neither the level of SFM and DORB and nor the enzyme A or B addition has resulted in a significant change in the mean egg weights except that in period 3 at 20 and 25% SFM and DORB levels when compared with 10 and 15% levels, and at 20 SFM and DORB levels with and without enzyme B. This could be due to random
variation and any possible hypothesis can be made only after much exploration into the topic.

Increasing levels of SFM and DORB resulted in non-significant numerical depression in egg weights up to 0.6 g between 10 and 25% SFM and DORB diet controls without enzymes. However, addition of enzymes resulted in non-significant numerical improvements up to 0.68 g in diets with and without enzyme addition. The highest egg weight recorded was 59.47g in 20% SFM and DORB diets with enzyme B addition and the lowest (58.68g) was recorded in 25% SFM and DORB diets without enzymes.

4.2.3 Feed Intake

Data on average daily feed intake of laying hens fed with 10, 15, 20 and 25% SFM and DORB diets with and without enzyme A or B during the six periods and their mean values are presented in Table 13 and graphically depicted in Fig.6.

The analysis of variance Table 13a revealed significant increase in feed intake as the levels of SFM and DORB are increased. The average daily feed consumption was 110.36, 114.57, 120.82 and 127.02 g/day/bird with 10, 15, 20 and 25% SFM and DORB levels, respectively. Supplementation of enzyme A and enzyme B significantly (P<0.05) reduced the feed intake by 3.49, 4.17, 5.20 and 5.74 g/day/bird and 3.21, 4.86, 6.03 and 6.57 g/day/bird, respectively, when compared to 10, 15, 20 and 25% SFM and DORB fed groups without enzymes. The highest feed consumption of 127.02 g/day/bird was observed in 25% SFM and DORB diet without enzyme supplementation and the lowest of 106.87 recorded in 10% SFM and DORB with enzyme A supplementation.

The feed intake values of laying hens fed diets with enzyme B mixture showed more beneficial effect over enzyme A during the entire experimental
periods. As the age of the laying hens advanced, there was an increasing trend of feed consumption from period 1 to period 6.

4.2.4 Feed efficiency

The efficiency of enzymes A or B supplementation to diets containing 10, 15, 20 and 25% SFM and DORB on feed efficiency expressed as kg feed per dozen of eggs and kg feed per kg of eggs are presented in Tables 14 and 15 and their graphical representation in figures 7 and 8.

The analysis of variance Tables 14a and 15a revealed significant (P<0.05) decrease in feed efficiency per dozen and per kilo of eggs as the level of SFM and DORB in the diets of hens were increased (10, 15, 20 and 25%). The supplementation of enzyme A significantly reduced the FE per dozen by 3.4, 3.8, 4.3 and 4.7% and enzyme B by 4.1, 5.2, 6.1 and 5.8% in the 10, 15, 20 and 25% SFM and DORB based diets when compared with respective controls without enzyme. Similarly, enzyme A significantly reduced the FE per kg of eggs by 3.4, 4.6, 4.8 and 5.3% and enzyme B by 4.3, 6.0, 6.9 and 6.9% in the 10, 15, 20 and 25% SFM and DORB diets when compared with respective controls without enzymes.

The FE values both on number and egg mass of the laying hens fed diets with enzyme mixture B showed more beneficial effect over enzyme A supplementation during the entire experimental period.

As the age of the birds advanced, there was a parallel increasing trend of FE observed from period 1 to period 6 as well as with the mean of all the levels of SFM and DORB based diets with and without enzyme A or B supplementation during the experimental period.

4.2.5 Intestinal viscosity
The intestinal viscosity of digesta of birds fed 10, 15, 20 and 25% SFM and DORB based diets with and without enzyme A or B addition at the end of the trial of 6 periods is presented in Table 16 and the graphical representation in Fig. 9.

The analysis of variance revealed a significant (P<0.05) reduction in intestinal viscosity. The viscosity decreased with the increasing levels of SFM and DORB in the diets. However, supplementation of enzyme A or B to these varying levels of SFM and DORB (10, 15, 20 and 25%) decreased the intestinal viscosity significantly (P<0.05) when compared to their respective controls without enzymes. (Plate 1 and 2)

4.2.6 Faecal moisture

The percent moisture content of faeces at the end of each period from laying hens fed 10, 15, 20 and 25% SFM and DORB diets with and without enzyme A or B is presented in Table 17 and graphically depicted in Fig.10.

The analysis of variance of Table 17a revealed significant (P<0.05) reduction in faecal moisture with increasing levels of SFM and DORB and the values were 74.71, 72.83, 66.79 and 64.83 corresponding to 10, 15, 20 and 25% SFM and DORB diet groups without enzymes.

The analysis of variance also revealed significant reduction in faecal moisture with enzyme A showing 71.98, 70.21, 65.55 and 61.79% and enzyme B showing 72.57, 66.09, 63.46 and 63.58% values as against the enzyme non-supplemented groups.

4.2.7 Livability

There was no mortality in the birds and they were in good health and active throughout the experimental period.

4.2.8 Relative economics
The cost effectiveness (per ton of feed) of the different dietary treatments (10, 15, 20 and 25%) of SFM and DORB based diets with enzyme A or B supplementation is presented in Table 18.

The results revealed that both the enzymes A and B are economical when added to (10, 15, 20 and 25%) SFM and DORB based diets as enzyme A recorded a net profit of rupees 91, 156, 142 and 149 and enzyme B recorded rupees 114, 200, 224 and 195, respectively as cost saving per ton of feed as against the control diets without enzyme supplementation.