The Effect of Jerusalem Artichoke (*Helianthus tuberosus* L.) on Blood Parameters, Liver Enzymes and Intestinal pH in Laying Hens

1Gultekin Yildiz, 1Pinar Sacakli, 2Tulin Gungor and 2Hamdi Uysal
1Department of Animal Nutrition and Nutritional Diseases,
2Department of Biochemistry, Faculty of Veterinary Medicine, University of Ankara,
Diskapi, Ankara, Turkey
3Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine,
University of Kirikkale, Yahşihan, 71451 Kirikkale, Turkey

**Abstract:** A study was conducted to determine the effect of, as a source of inulin, Jerusalem artichoke on intestinal pH, some blood parameters and liver enzymes of laying hens. Control and treatment groups were fed a diet containing 0, 5 and 10% Jerusalem artichoke, respectively. Twenty five weeks old, 45 commercial white laying hens were used in the experiment. In this experiment, inulin was effective on modifying of intestinal characteristics, blood metabolites and liver enzymes in laying hens. Fecal and intestinal pH values were not altered by dietary treatments. Although, uncharged serum cholesterol and albumen content, 5% JA increased glucose (p<0.001) and decreased fructose (p<0.01), triglyceride (p<0.01) and total protein (p<0.05) contents when compared with control diet. On the other hand, 10% JA reduced serum glucose as well as fructose levels. Serum SGOT levels was increased (p<0.01) by 5% JA addition and ALP levels was decreased (p<0.05) by 10% JA.

**Key words:** Jerusalem artichoke, blood parameters, liver enzymes, intestinal pH, laying hen

**INTRODUCTION**

Inulin are composed of short chains of fructose molecules found extensively distributed in nature as plant storage carbohydrates. They are present in greater than 36,000 plant species (Niness, 1999; Guarner, 2005).

The use of inulin and fructooligosaccharide (FOS) in the diets of livestock is a relatively recent effort. They are used for their effects on the colonic microflora, gastrointestinal physiology, immune function and bioavailability of minerals, lipid metabolism and gastrointestinal tract health (Roberfroid, 1999). Several studies have been conducted to investigate the effects of inulin or FOS on livestock animals. Fructooligosaccharide supplementation reduces pathogen colonization and contamination in poultry (Patterson and Burkholder, 2003; Verdonk *et al.*, 2005). Data from poultry suggest that FOS may be as effective as antibiotic in the control of pathogens and improvement of growth performance (Griggs and Jacob, 2005). Many issues remain unresolved concerning probiotic oligosaccharides. The composition of the colonic microflora, gastrointestinal health and clinical or performance effects in the animal should be investigated.

This research was carried out to determine the effect of, as a source of inulin, Jerusalem artichoke on intestinal pH, some blood parameters and liver enzymes of laying hens.

**MATERIALS AND METHODS**

This study was conducted in University of Ankara, Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutritional Diseases in 2003. Twenty-five-weeks-old, 45 commercial white laying hens were used in the study. They were divided into one control and 2 treatment groups each containing 15 hens. The feeding period lasted 16 weeks. Three birds were housed per 45×45×45 cm wire cage, given feed and water for *ad libitum* intake throughout the experiment and subjected to a photoperiod of 17 h light/day. Its temperature was maintained between 16 and 25°C. The control group was

**Corresponding Author:** Tulin Gungor, Department of Animal Nutrition and Nutritional Diseases,
Faculty of Veterinary Medicine, University of Kirikkale, Yahşihan, 71451 Kirikkale, Turkey

1297
Table 1: Ingredient of the experimental rations

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Control group</th>
<th>5% JA</th>
<th>10% JA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>36.5</td>
<td>3.43</td>
<td>31.3</td>
</tr>
<tr>
<td>Corn</td>
<td>30.0</td>
<td>26.0</td>
<td>22.0</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>19.0</td>
<td>15.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Poultry meal</td>
<td>3.2</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Vetch</td>
<td>-</td>
<td>5.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Jerusalem artichoke (dried)*</td>
<td>-</td>
<td>5.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1.6</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Limestone</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Vitamin-Mineral premix**</td>
<td>0.35</td>
<td>0.35</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Chemical composition

- Dry matter: 94.21
- Crude protein: 16.90
- Ether extract: 3.36
- Crude fiber: 3.78
- Calcium: 3.40
- Phosphorus: 0.63

Metabolizable energy, kcal kg⁻¹: 2654.00, 2651.00, 2648.00

*Jerusalem artichoke contains 15.80% inulin on a dry matter basis.
**Supplied per kilogram of diet: vitamin A, 12,000 IU; vitamin D, 1,200 IU; vitamin E, 15 mg; vitamin K₃, 3 mg; vitamin B₆, 3 mg; vitamin B₉, 5 mg; vitamin B₁₂, 15 mcg; niacin, 18 mg; Ca-D-pantothenate, 6 mg; folinic acid, 0.6 mg; vitamin C, 20 mg; coline chloride, 250 mg; manganese, 100 mg; zinc, 60 mg; cobalt, 3 mcg; iodine, 1.8 mcg; copper, 5 mcg; iron, 40 mg

The data were statistically analyzed by one-way Analysis of Variance (ANOVA) (SPSS Inc., Chicago, IL, USA) followed by Duncan’s multiple range test (Duncan, 1955). Mean values were considered significantly different at (p<0.05).

RESULTS AND DISCUSSION

Inulin content of Jerusalem artichoke was found as 15.80% in dry matter basis. Fecal and intestinal pH values were not altered by dietary treatments (Table 2). Although, unchanged serum cholesterol and albumen content, 5% JA increased glucose (p<0.001) and decreased fructose (p<0.01), triglyceride (p<0.01) and total protein (p<0.05) when compared with control diet. On the other hand, 10% JA reduced serum glucose as well as fructose levels (Table 3).

The content of SGOT level was increased (p<0.01) by 5% JA and unchanged by 10% JA. SGPT and LDH levels remained unchanged by the treatment. ALP level was decreased (p<0.05) by 10% JA compared with control and 5% JA diet (Table 4).

In this experiment fecal and intestinal pH were not changed both levels of JA. These results similar to Houdijk et al. (1998) investigated lower levels of oligofructose (7.5 and 15 g kg⁻¹ diet) in 57 day old pigs. They found that there were no significant differences in fecal pH between the groups. These results differ from those reported in 30-day-old weanling piglets fed 40 g kg⁻¹ diet oligofructose, which determined an increase (p<0.05) fecal pH compared with the control diet (5.6 in control, 6.2 in oligofructose) (Houdijk et al., 1999). They did not report fecal dry matter percentage like our study. The authors attributed the rise in fecal pH to the complete disappearance of oligofructose prior to the distal colon in addition to a possible increase in proteolytic activity in the colon. In contrast to higher levels (e.g., 40 g kg⁻¹), lower levels of inulin may have no effect on fecal pH. This data confirmed the results of Roberfroid (1993), who reported that less than 10% of inulin level has no effect.

In contrast to our expectation, plasma fructose concentration was decreased by inulin supplementation. Furthermore, glucose concentration was increased by 5% JA supplementation but 10% JA as compared to control. Diez et al. (1998) determined that there were no differences in plasma glucose and inulin due to 70 g kg⁻¹ inulin in dog diets. Indeed, Diez et al. (1997) found that 80 g kg⁻¹ inulin diet tended (p>0.05) to reduce postprandial plasma glucose concentrations as compared to the control. And they reported that at higher levels inulin may play a role in modulation of blood metabolites and be useful in diabetic dog diets. Our result was not confirmed this finding. Because in the present study the
lower level of insulin (5% JA) increased plasma glucose concentration while the higher level (10% JA) did not change. There is no result the effect of insulin on plasma glucose and fructose concentration in poultry. These discrepancies may be resulted from animal species, diet and insulin concentration.

Serum triglyceride and total protein concentrations were decreased significantly by 5% JA supplementation and numerically by 10% JA as compared to control. On the other hand, cholesterol content tended to decrease (p<0.05) by the treatments when compared with the control diet. Yusrizarl and Chen (2003) reported adding insulin or oligofructose at the level of 1% reduced (p<0.05) that serum cholesterol for broilers. They attributed this reduction to the cholesterol assimilation by the Lactobacilli or to the co-precipitation of cholesterol with deconjugated bile salts (Gilliland et al., 1985). In another study conducted with dogs, Diez et al. (1998) reported that there was no difference in plasma cholesterol and triglyceride due to insulin at the level of 70 g kg⁻¹ diet. However, Diez et al. (1997) found that after 6 weeks, 80 g kg⁻¹ insulin resulted in a reduction (p<0.05) in plasma triglyceride concentrations in dogs.

Serum SGOT levels was increased (p<0.01) by 5% JA addition and ALP levels was decreased (p<0.05) by 10% JA. Insulin may play a role in modulation of liver enzymes but, we are unable to find any reported studies investigated the effect of insulin on liver enzymes. In conclusion, insulin may play a role in modulation of intestinal characteristics, blood metabolites and liver enzymes. Studies should be continued to determine the most effective dose as well as diet and feeding period according to the animal species.

REFERENCES


