

## RESEARCH COMMUNICATIONS

3.49 ± 0.20 and 3.09 ± 0.15 kg respectively. Their abdominal fat pad weights determined by slaughtering at the end of the experiment were 192.28 ± 9.10, 120.24 ± 10.10 and 82.74 ± 6.75 g respectively.

The birds fasted overnight were infused insulin at 1 IU/kg body weight in the wing vein. One blood sample was drawn into a clean heparinized glass vial from the wing vein of each bird just prior to the injection. Subsequent blood samples were similarly taken from 2 birds in each group at 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 h post-injection. The birds were sacrificed after 3 h and their abdominal fat pad weights determined.

Protein-free filtrate of an aliquot of the blood sample was prepared immediately after collection for subsequent analysis of blood glucose following Folin and Wu<sup>5</sup>. Plasma was separated from the rest of the blood samples immediately and stored at -20°C till further analysis for free fatty acids<sup>6</sup>, cholesterol<sup>7</sup> and very low density lipoprotein (VLDL) + low density lipoproteins<sup>8</sup> (LDL). The data so obtained were subjected to statistical analysis<sup>9</sup>.

The basal levels of blood glucose were statistically similar in all the three groups (Table 1). The values observed were similar to those reported by Sturkie<sup>10</sup>. An abrupt and significant decline in blood glucose level was observed in all the three groups within 30 min following the insulin injection. The decline was minimum in the high body weight group. However, the levels showed an increase in the medium and low body weight groups by one hour post-injection and the values continued to fall in the heavier birds till 1.5 h post-injection. In the other two groups the levels fell by 1.5 h post-injection. The lowest levels were observed at 1.5 h post-injection in high and medium body weight groups whereas in the lower body weight group the

lowest values were recorded at 2.5 h post-injection.

The increase in glucose levels seen after 1 h post-injection in the medium and low body weight groups could be due to endogenous reflex secretion of glucagon to offset the rapidly declining glucose levels. Both medium and low body weight group birds exhibited typical insulin shock response by a sudden fall in the plasma glucose level, followed by reflex elevation under the influence of glucagon and then further decline due to the influence of insulin<sup>10</sup>. The obese individuals responded differently probably due to some resistance to the action of insulin and delayed response. These findings support the theory of insulin-glucose imbalance in the obese individuals<sup>2</sup>.

The basal-free fatty acid levels were lowest in the low body weight group though the differences between the three groups were statistically not significant (Table 1). The levels in high and medium body weight groups fell up to 1 h post-injection and thereafter peaked by 2.0 and 2.5 h respectively before falling back towards the basal levels. The response of low body weight birds was, however, different. The levels started rising following insulin injection and peaked by 1.5 h post-injection and thereafter fell towards the basal levels.

In contrast to most mammalian species where exogenous insulin causes a decrease in the plasma-free fatty acids, an increase has been observed in our study. Similar findings have been reported earlier<sup>11</sup>. The response of the three types of birds appears to be different when compared to the response of plasma glucose level.

The response of the heavy birds showed similarities. As the blood glucose level fell, free fatty acid level increased in these birds. Liver is the major site of fatty acid synthesis in chicken and humans<sup>4</sup>. Hence in

**Table 1.** Glucose, free fatty acids, cholesterol, VLDL + LDL in high, medium and low body weight groups of hens after insulin injection.

| Body wt. range          | 0                           | 0.5                          | 1.0                          | Time (h)<br>1.5              | 2.0                          | 2.5                          | 3.0                          |
|-------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| Glucose (mg %)          |                             |                              |                              |                              |                              |                              |                              |
| High                    | 211.06 <sup>a</sup> ± 8.33  | 157.90 <sup>ab</sup> ± 18.86 | 141.25 <sup>ab</sup> ± 11.85 | 116.59 <sup>bc</sup> ± 7.66  | 133.33 <sup>ac</sup> ± 18.31 | 160.44 <sup>ab</sup> ± 6.27  | 162.66 <sup>ab</sup> ± 20.73 |
| Medium                  | 186.68 <sup>a</sup> ± 11.46 | 110.66 <sup>ab</sup> ± 14.37 | 125.83 <sup>ab</sup> ± 20.83 | 112.49 <sup>ac</sup> ± 18.33 | 128.16 <sup>ab</sup> ± 25.06 | 122.33 <sup>ab</sup> ± 35.10 | 152.46 <sup>ac</sup> ± 23.29 |
| Low                     | 185.99 <sup>a</sup> ± 13.02 | 134.49 <sup>ab</sup> ± 18.83 | 143.66 <sup>ab</sup> ± 13.10 | 109.33 <sup>ac</sup> ± 11.49 | 107.16 <sup>ac</sup> ± 10.32 | 104.33 <sup>ac</sup> ± 8.55  | 146.29 <sup>ab</sup> ± 24.20 |
| Free fatty acids (mg %) |                             |                              |                              |                              |                              |                              |                              |
| High                    | 97.28 ± 24.43               | 96.60 ± 15.30                | 91.60 ± 22.48                | 144.50 ± 32.50               | 173.33 ± 38.44               | 80.00 ± 37.83                | 92.50 ± 62.50                |
| Medium                  | 111.05 ± 16.76              | 97.50 ± 13.37                | 82.37 ± 17.60                | 127.33 ± 22.56               | 125.66 ± 55.75               | 145.00 ± 74.99               | 78.00 ± 4.47                 |
| Low                     | 78.21 ± 26.62               | 141.00 ± 11.81               | 80.00 ± 5.00                 | 181.25 ± 68.75               | 121.87 ± 15.53               | 85.63 ± 36.27                | 113.12 ± 37.18               |
| Cholesterol (mg %)      |                             |                              |                              |                              |                              |                              |                              |
| High                    | 18.39 <sup>a</sup> ± 1.26   | 17.33 <sup>a</sup> ± 1.91    | 12.25 <sup>ab</sup> ± 3.29   | 18.33 <sup>a</sup> ± 0.73    | 19.50 <sup>a</sup> ± 3.91    | 11.83 <sup>ab</sup> ± 0.44   | 16.50 <sup>ab</sup> ± 1.40   |
| Medium                  | 14.00 <sup>a</sup> ± 1.87   | 16.17 <sup>a</sup> ± 1.17    | 12.00 <sup>ac</sup> ± 2.52   | 10.63 <sup>ab</sup> ± 0.90   | 14.00 <sup>a</sup> ± 1.76    | 11.25 <sup>ab</sup> ± 4.75   | 12.45 <sup>ab</sup> ± 1.04   |
| Low                     | 19.21 <sup>a</sup> ± 2.12   | 14.37 <sup>ab</sup> ± 1.85   | 12.00 <sup>ab</sup> ± 2.52   | 12.63 <sup>ab</sup> ± 1.93   | 14.60 <sup>ab</sup> ± 2.24   | 11.50 <sup>bc</sup> ± 0.61   | 15.50 <sup>ab</sup> ± 2.29   |
| VLDL + LDL (moles/l)    |                             |                              |                              |                              |                              |                              |                              |
| High                    | 2.36 <sup>a</sup> ± 0.37    | 2.84 ± 0.19                  | 2.95 ± 0.29                  | 2.52 ± 0.56                  | 2.00 ± 0.50                  | 3.24 <sup>ab</sup> ± 0.17    | 3.25 <sup>ab</sup> ± 0.25    |
| Medium                  | 2.57 <sup>a</sup> ± 0.30    | 3.35 <sup>ab</sup> ± 0.15    | 2.81 ± 0.14                  | 2.22 ± 0.07                  | 2.88 ± 0.31                  | 1.005 <sup>ac</sup> ± 0.005  | 1.55 <sup>ac</sup> ± 0.31    |
| Low                     | 2.99 <sup>a</sup> ± 0.30    | 2.87 <sup>a</sup> ± 0.25     | 1.70 <sup>ab</sup> ± 0.62    | 2.60 ± 0.23                  | 2.66 ± 0.13                  | 2.65 ± 0.06                  | 2.11 <sup>ac</sup> ± 0.40    |

\**P* < 0.01 Duncan's multiple range test.

Means with different superscripts differ significantly.

response to exogenous insulin there is a fall in the blood glucose levels followed by a corresponding increase in plasma-free fatty acids. As the response of glucose in medium and light weight birds was more rapid, this was reflected in rapid elevation of free fatty acids in low body weight birds.

When liver glycogen concentration increases beyond 5–6% it inhibits further glycogen synthesis, and all the additional glucose entering the liver cell becomes available for fatty acid synthesis<sup>12</sup> for subsequent synthesis of triglyceride. Insulin influences triglyceride synthesis and fatty acids are provided by plasma under the influence of insulin<sup>9</sup>. The cholesterol level in all the three groups fell significantly ( $P < 0.01$ ) from the basal level following insulin injection and reached lowest level between 1 and 1.5 h post-injection. Thereafter the level again started to increase and higher elevation was observed in the high body weight group compared to the other two groups. This is similar to the findings of Gill *et al.*<sup>3</sup>

The VLDL+LDL levels showed variations contrary to those of glucose level ( $P < 0.01$ , Table 1). An elevation in the circulating level of plasma lipoprotein was observed in all the three groups, corresponding to a decline in the glucose level. As the glucose level started rising the VLDL+LDL levels started falling except in the birds of heavy body weight. Among the three groups of birds, the heavy body weight group birds attained higher levels of VLDL+LDL which remained elevated for a longer time compared to the other two groups. This indicates a significant difference in the response of obese individuals towards production and transport of triglycerides from the liver under the influence of insulin. The longer duration of elevated plasma levels of VLDL+LDL in these birds indicates

greater synthesis and transport of triglycerides from the liver. The concentration of VLDL+LDL in circulation is one of the major factors determining the rate of fat deposition and is well-correlated with total body fat content<sup>13,14</sup>.

It is evident from these findings that the response to exogenous insulin is different in lean and obese individuals. Obese individuals are better convertors of plasma glucose into triglycerides under the influence of insulin and thus they store greater amount of fat in the body.

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6 January 1989; revised 6 July 1989