REPORT FOR THE CHARDON LL HEARING

NON-SUITABILITY OF GENETICALLY ENGINEERED FEED FOR ANIMALS

Presented by Scientists for Global Responsibility
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1. INTRODUCTION

Chardon LL is intended to be fed, as a whole plant, to cattle. No experiments on the suitability of such a diet have been made. Approval of the application of Aventis for commercial growing of this maize in the United Kingdom was granted on the basis of two animal-feeding experiments, one on the feeding of maize kernels to chickens and the other on the feeding of the isolated GM protein to rats. In both experiments, the investigators concluded that the tested animals consumed food and gained weight normally. The present report re-analyses the data and reaches a different conclusion.

Anecdotal evidence is also presented that animals seek to avoid GM food and do not thrive if forced to consume such food.

2. EXPERIMENT ON FEEDING OF GLUFOSINATE-RESISTANT MAIZE TO CHICKENS

2.1 The experiment

The study is entitled 'The Effect of Glufosinate Resistant Corn on the Growth of Male Broiler Chickens'. The purpose was apparently 'to detect differences in nutrient quality of corn samples' (p. 1 of the study). The duration of the experiment was 42 days.

In this study, 280 young broiler chickens of a commercial strain were used, divided into two groups. One group ate AgrEvo's (Aventis's) glufosinate-resistant maize, the other ate University of Guelph maize, a non-GM variety. Both diets were a conventional maize-soya type of diet; and both were adjusted on the same days, as appropriate for different stages of growth. The GM maize and the non-GM maize appear to be different varieties, and so the study is flawed in this respect because two varieties may differ in their nutritional properties.

All chickens were allowed to eat at will.

2.2 The stated conclusions of the study

The stated results and conclusion of the official report are:

'Results of live bird traits … show that source of corn … had no effect on body weight, feed intake, … or percent mortality over the experimental period …'

'Glufosinate tolerant corn from the U.S.A. is comparable in feeding value, for 0-42 day broilers, relative to the commercially available corn hybrid.
Therefore, the nutritive value of glufosinate tolerant corn hybrid is equivalent to a commercially available corn hybrid.'

The mortality rate was judged to be normal.

2.3 Re-examination of body weights

Fig. 1a shows the body weights of the chickens in the two groups as a function of time. By the end of the study, the chickens on the genetically modified diet (represented by the red curve) have, on average, weights only 1 % below the average weight in the control group (black curve), which is insignificant. However, the error bars, shown by dotted lines for both groups, are much greater for the chickens fed on the glufosinate-resistant maize. Initially the weights of the chickens and the errors bars are nearly identical, but the percentage error grows much faster for the glufosinate-fed group, as is evident from Figs. 1a and 1b, the latter being a larger-scale plot of the last 11 days of the experiment. Numerical values are given in Table 1 of the study [not reproduced here]. In spite of the fact that the body weights themselves never differ by as much as 1%, the errors quoted, which are initially the same, grow much more rapidly for the test group. On day 32 the errors are nearly twice as great for the test group; and on day 42 they are 2.5 times greater. Data for individual chickens have not been supplied, and it is not clear how extreme the individual weights of the birds might have been.

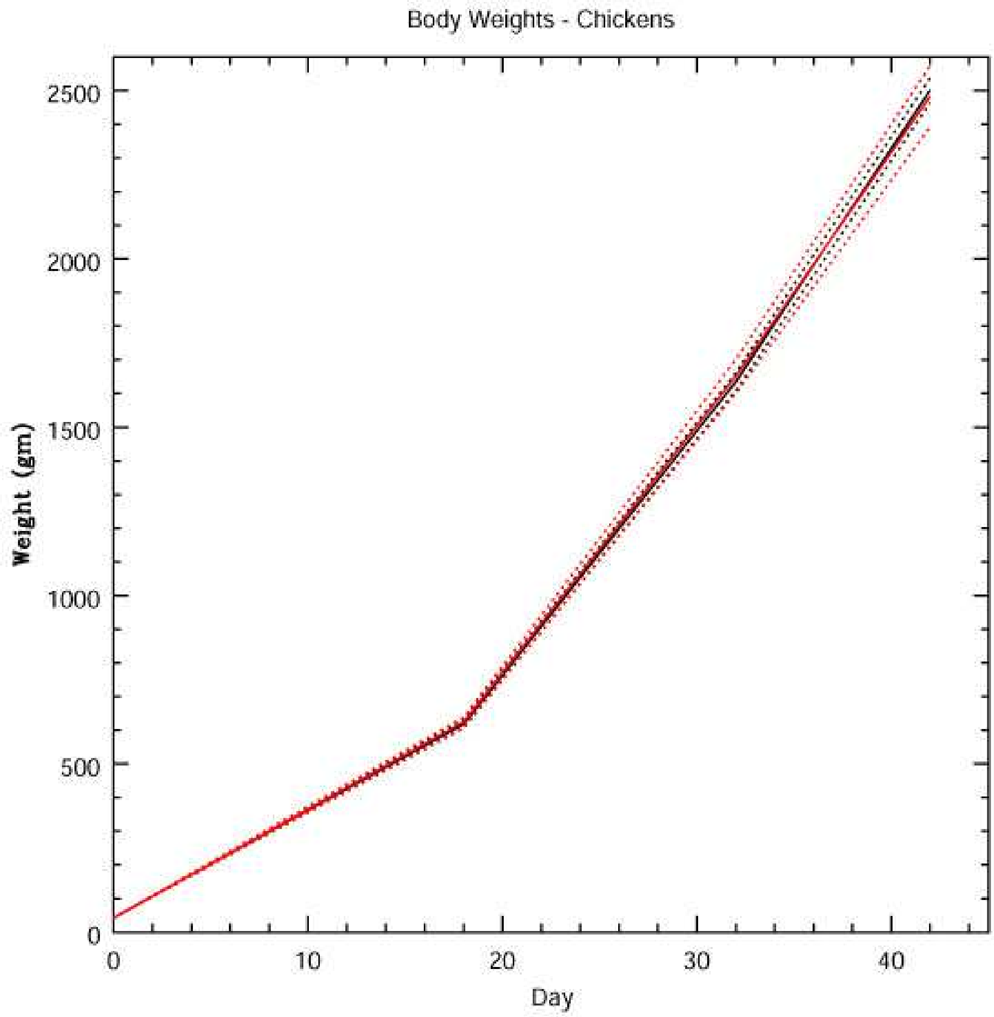

Figure 1a - Chicken Body Weights (all days)

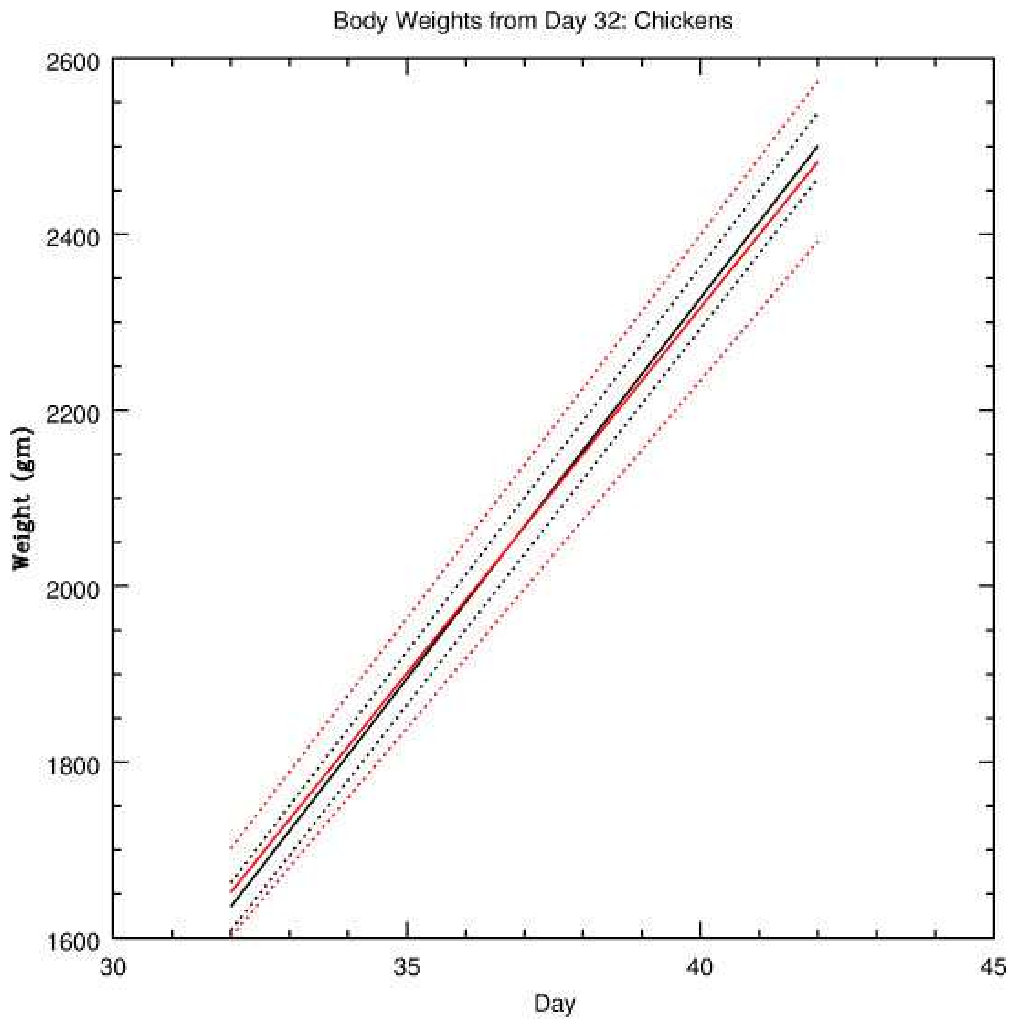

Figure 1b – Chickens Body Weight from Day 32

2.4 Re-examination of food consumption

Fig. 2, based on Table 2 of the study [not reproduced here], gives total food consumption during the intervals between measurements. During the first phase of the experiment (days 0-18), the test group consumed 9 gm more than the control group; during the second phase (18-32 days), consumption had dropped to 7 gm less; and in the final phase (days 32-42) consumption by the test group had fallen to 63 gm less than that of the control group.

Again, the error bars are much greater for the test group and increase with time: over the first interval they are only 1.3 times greater, but this ratio grows to 2.6 for the second interval and to 3.4 for the third and last interval.

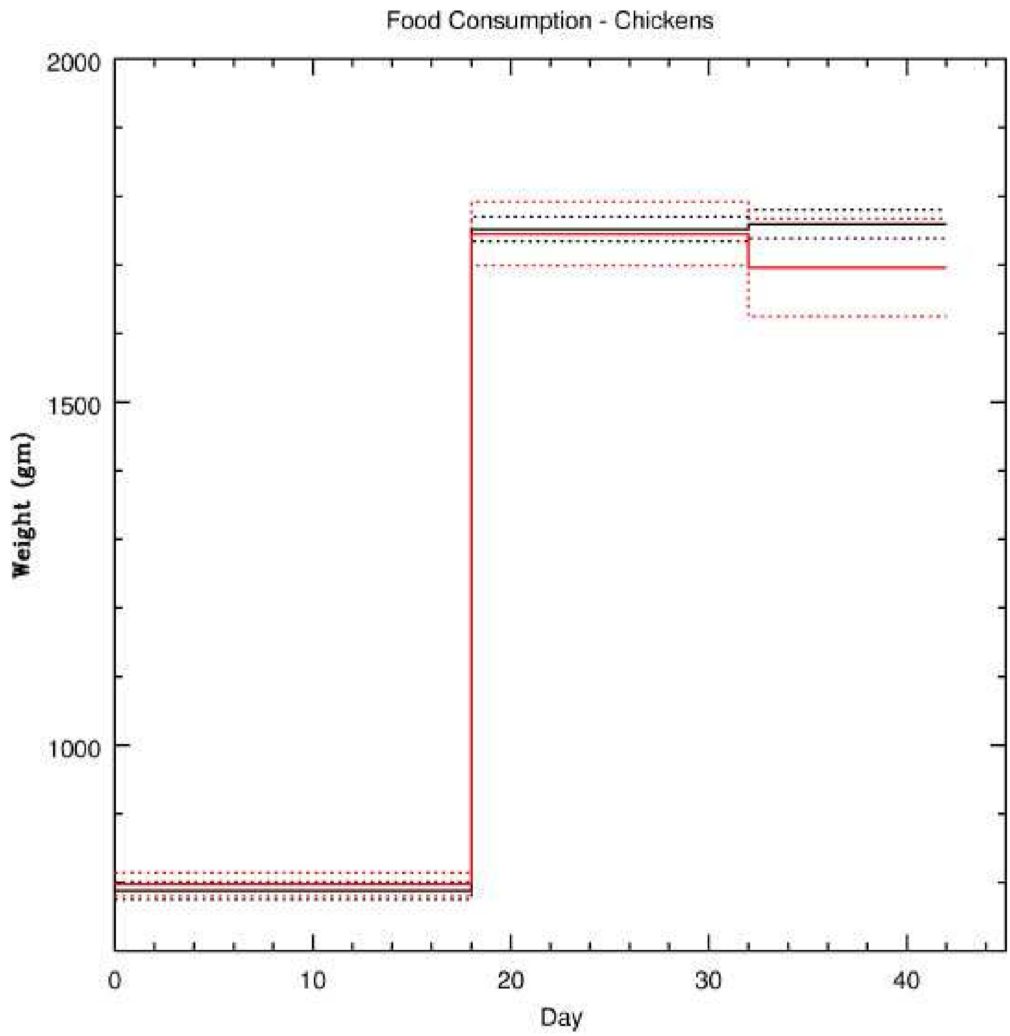

Figure 2 – Chicken Food Consumption

2.5 Mortality and statistics

Information on deaths during the study is given only in the form of mortality, 7.14 ±5.47 % for chickens eating the glufosinate-resistant maize and 3.57 ±4.29 % for those fed commercial hybrid corn. Although the former values are twice those of the latter, the study points out that values of 5 to 8 % in male broilers are normal at this laboratory.

In justification of the conclusion of the study that percentage of mortality is unaffected by the feeding of the GM maize, it is stated that 'we normally see values of 5 to 8 % in male broilers.' Nevertheless, it may be significant that the mortality rate was twice as high amongst the chickens eating the glufosinate-resistant maize (7.14 ±5.47 % between days 0 and 42) as compared with those fed commercial hybrid corn (3.57 ±5.47 % between days 0 and 42).

2.6 Conclusions on the chicken study

Average body weights and feed intakes do not vary significantly, as concluded in the study. Nevertheless, the much larger error bars for both these quantities give concern that the weight gains and the feeding patterns were erratic in the treated group, indicating that at least some of the chickens were not thriving on the glufosinate-resistant maize.

There were twice as many deaths amongst chickens fed the GM maize as there were amongst those fed non-GM maize, although the study considered the number of deaths to be normal.

3. EXPERIMENT ON FEEDING OF PAT-PROTEIN TO RATS

3.1 The experiment

This experiment was sponsored by HOECHST SCHERING AgrEvo GmbH (note that AgrEvo is now Aventis) in support of an application in the United Kingdom to have the genetically modified maize Chardon LL added to the National Seed List. The experiment was accepted as evidence of safety of the maize for the feeding of cattle.

The report on this experiment is entitled 'PAT-PROTEIN – Repeated Dose Oral Toxicity (14-Day Feeding) Study in Rats'. This study on rats, like that on chickens, has little relevance to cattle, as the digestive systems of these animals are very different: cattle are ruminants and have four stomachs. Furthermore, it was not the maize itself, Chardon LL, but the isolated PAT-protein it contains that was tested; and the effects of feeding the isolated protein must be expected to differ from the effects of feeding the whole maize. Also, the very short time during which the experiment was pursued gives no indication of possible long-term effects of feeding over a lifetime, especially when the maize is to be fed to a very different animal species. Only five male rats and five female rats were used in each of the four groups, and the individual rats had substantial differences in weight even at the start of the experiment. While we believe that the experiment was faulty and that no firm conclusions can be drawn from it, we have re-examined the measurements to confirm, or otherwise, the internal consistency of some of the conclusions drawn in the study.

The original proposal submitted by the laboratory performing the experiment was for a 10-day study; however, this was rejected by the sponsor and it was agreed that a 14-day study would be undertaken. Although it is stated (p. 15, para. 2) that 'This study should provide a rational basis for toxicological risk assessment in man', the conclusions are somewhat pre-empted (p.18, middle) by the statement that 'As PAT-PROTEIN consists of normal amino acids it was not expected to cause any remarkable toxicity. Therefore, a treatment period [*i.e.*, length of experiment] of 14 days was considered to be sufficient.'. (In fact, measurements of body weight and food consumption spanned only 13 days.) Measurements were made only on Days -5 (pre-test), 1, 3, 7, 9 and 13. Only body weights and food consumption will be discussed in this report.

Although the purpose of the study was to test for toxicity, the data provide evidence that the animals may not be thriving on a diet including the PAT-protein. The evidence for this suggestion, from body weights and food consumption, will be examined below. Firstly, however, it is necessary to describe the experiment.

A total of 40 rats took part. They were delivered to the laboratory at the age of about 4 weeks, and so were very young animals that were growing rapidly. There were two control groups and two test groups, each group containing 5 males and 5 females. Body weights at the beginning of the experiment varied between 53 and 82 gm for males and between 50 and 74 gm for females. The groups were divided as follows:

- Group 1: CONTROL group, given a diet normal for laboratory rats throughout the experiment. In the 5-day acclimatisation period preceding the experiment, all rats were given this diet, which provided the standard of total protein content of 50'000 ppm [*sic*] to which the diets of the other three groups were adjusted.
- Group 2: TEST group given a low dose of PAT-protein, 5'000 ppm, plus 45'000 ppm of soya protein.
- Group 3: TEST group given a high dose of PAT-protein, 50'000 ppm, without soya protein.
- Group 4: CONTROL group without PAT-protein but containing 50'000 ppm of soya protein.

In terms of similarity of diet, the test groups should better be compared with Group 4 than with Group 1.

All animals were allowed to eat at will.

Measurements of body weights and of food consumption were made during pre-test (6 days before Day 1, when the experiment began) and on Days 1 (before administering the new diets) and on days 3, 7, 9 and 13, although the last two measurements had been scheduled for days 10 and 14.

3.2 The stated conclusions of the study

The results of the study are summarised on p.34 of the study:

'Average mean food consumption over treatment was in the same range for treated groups and controls.'

'Occasionally recorded differences between controls and treated groups were generally small, showed no dose-relationship or consistent trend. They are considered to lie within the normal range of biological variation for rats of this age and strain housed under the conditions described above.'

'Mean body weights were similar for treated groups and controls. There were no differences which could be attributed to treatment with the test article.'

3.3 Re-examination of body weights

Weights of individual rats were not plotted or analysed in the published study, but we investigate these below.

Fig. 3a (p.39 of the study) plots the body weights of male rats, averaged within each group, against time during the experiment. The rats in Group 2 (dotted curve), which received the low dose of PAT-protein, gained weight at nearly the same rate as control Group 1 (solid curve), which received the standard rat diet. On the other hand, the rats in Group 3 (dashed curved), eating the high-dose of PAT-protein, gradually fell below all other groups, although they had been marginally the heaviest at the beginning of the experiment.

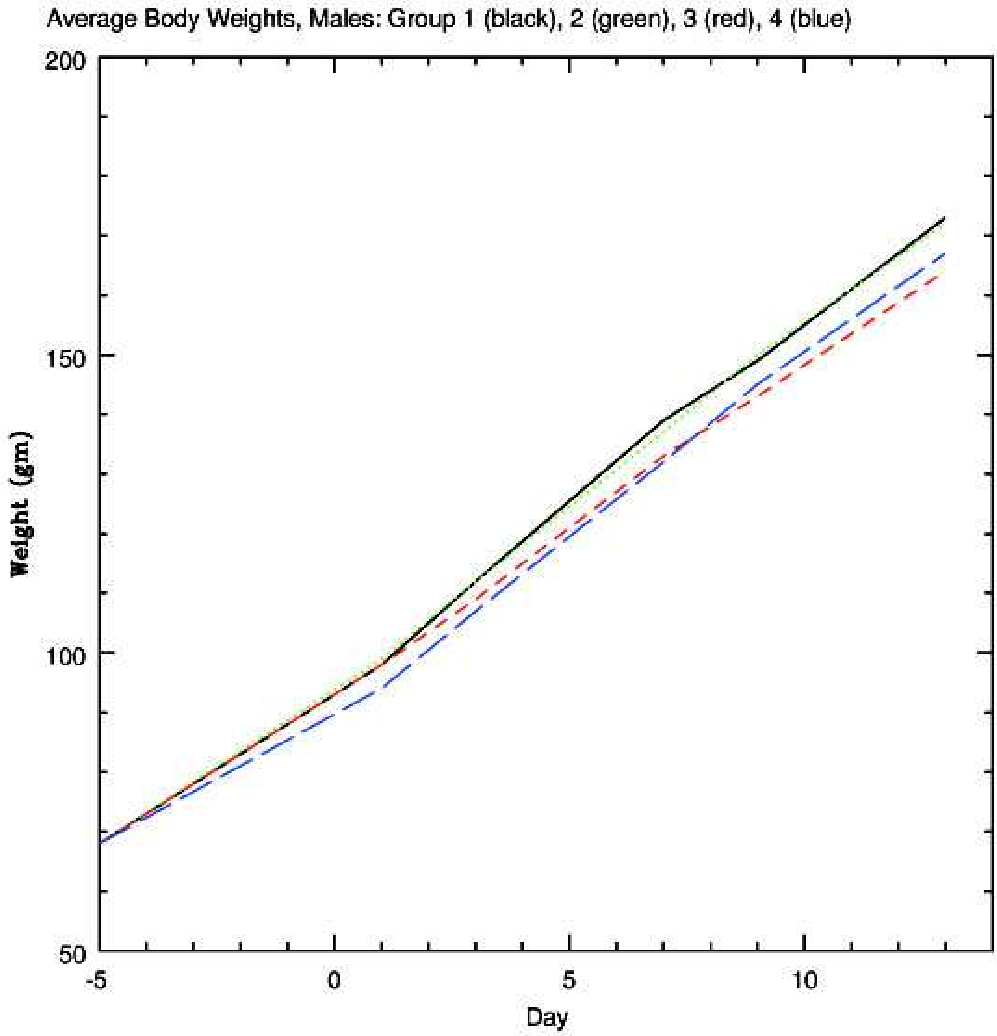

Figure 3a – Average body weights for male rats

[N.B.: This figure differs slightly from that which appears in the study and which was presented to the Chardon LL Hearing. There is confusion amongst the figures, tables and text of the study as to the Days (horizontal scale) on which measurements were taken. This figure has been re-plotted to conform to the tables, which appear to have the correct dates.]

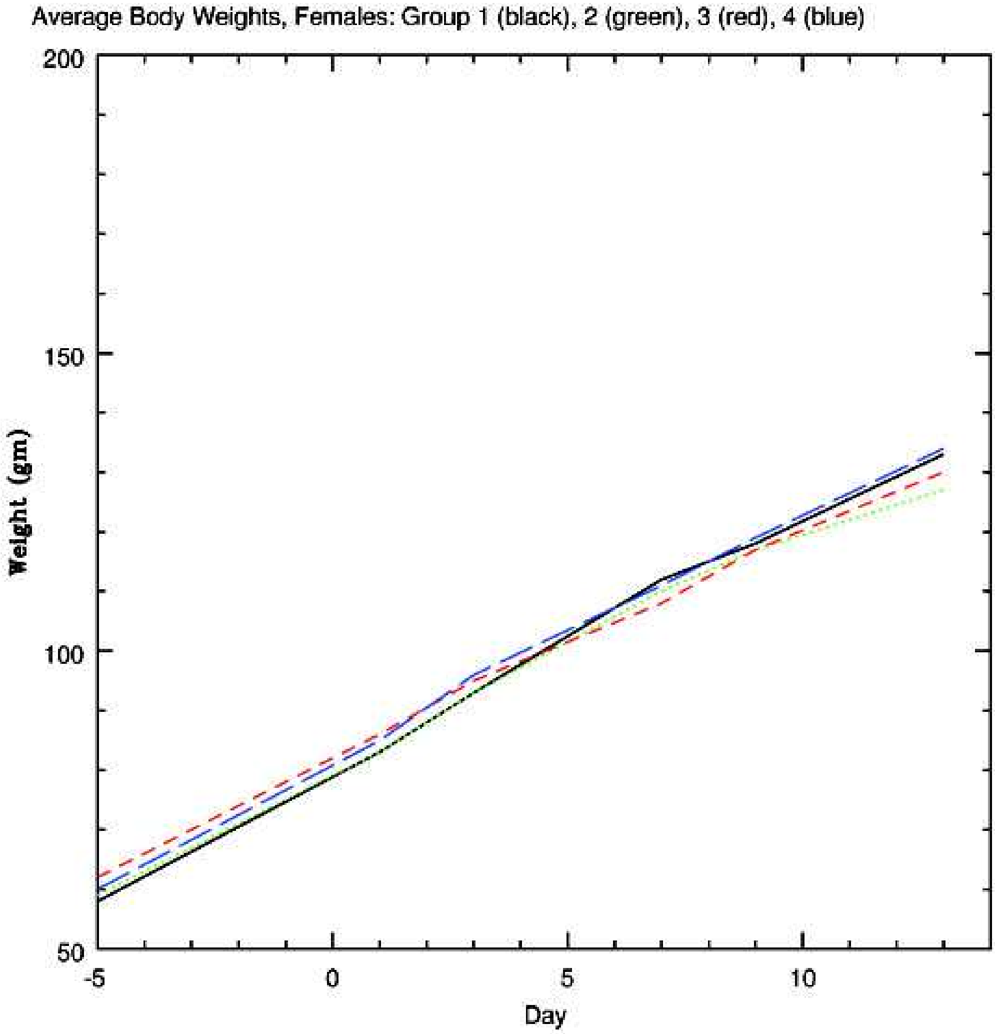

Figure 3b – Average body weights for female rats

Fig. 3b (p. 40 of the study) shows a similar plot for the body weights of female rats. The rats in Groups 2 and 3 (dotted curve and dashed curve, respectively), eating the PAT-protein, gradually fell below the control groups; Group 3 had been the heaviest group at the beginning of the experiment.

[N.B.: The same note as for Fig. 3a applies.]

Figs. 4a-c and 5a-c are not in the published study.

[N.B.: Owing to the inconsistencies mentioned in the note to Fig. 3a, the figures presented to the Chardon LL Hearing were plotted with the first point at Day –4. Here, this date has been revised to Day –5 for all of Figs. 4 and 5.]

Fig. 4a plots body weights of individual males from the two control groups: black curves, for Group 1 (normal rat diet) and blue curves for Group 4 (soya-added diet). Eight of the curves are initially nearly parallel, but the black dot-dashed curve rises and the blue dot-dashed curve falls with respect to the others. From Day 3, these two curves progress normally. A noticeable downturn occurs between Days 7 and 9 for the black dotted curve and black long-dashed curve, but the slopes thereafter are normal Following Day 9, all slopes are nearly the same.

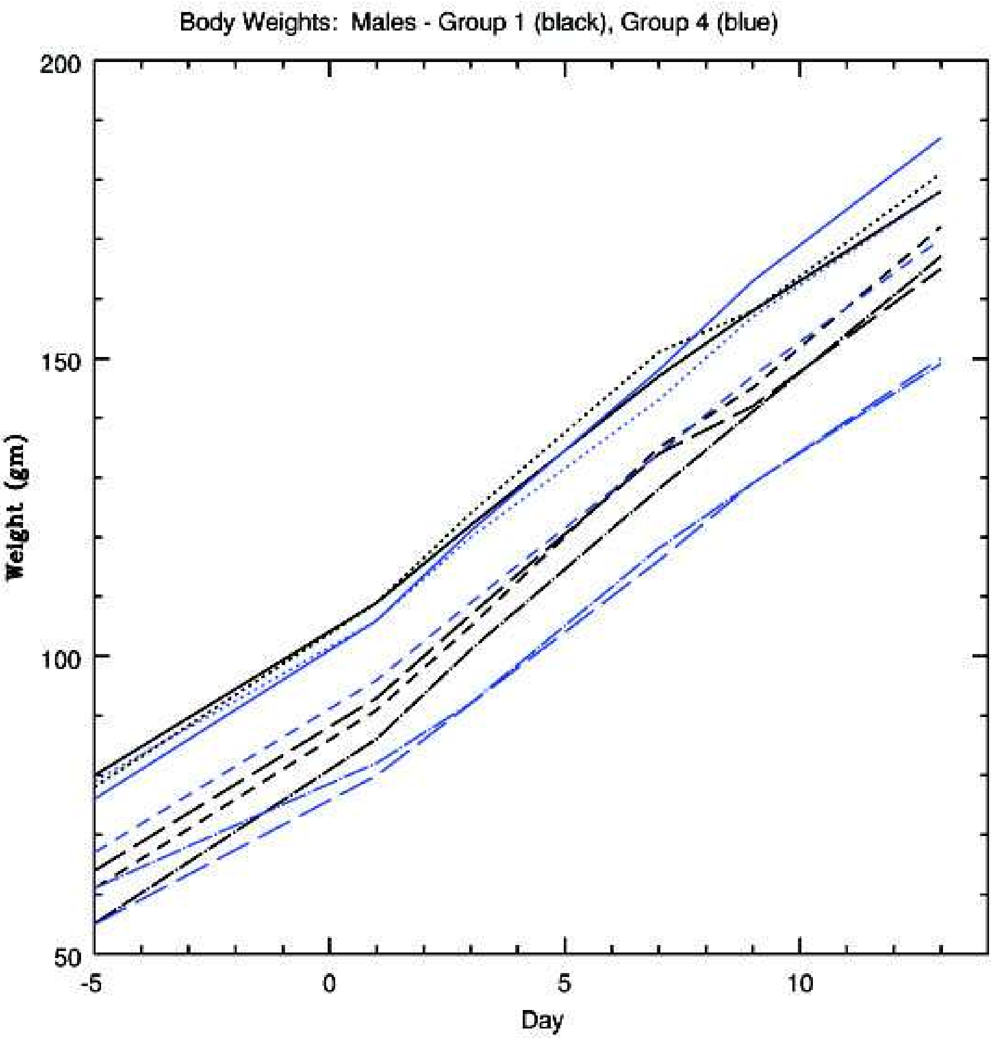

Figure 4a – Weights of individual makes from two control groups

Fig. 4b plots body weights of individual males of Group 2 (green curves), which were fed the low-PAT-protein diet, together with the curves for the control groups of Fig. 4a. Two of the green curves (dot-dashed and long-dashed) fall progressively below other curves from Day 3, indicating that these animals are gaining weight less rapidly than the others.

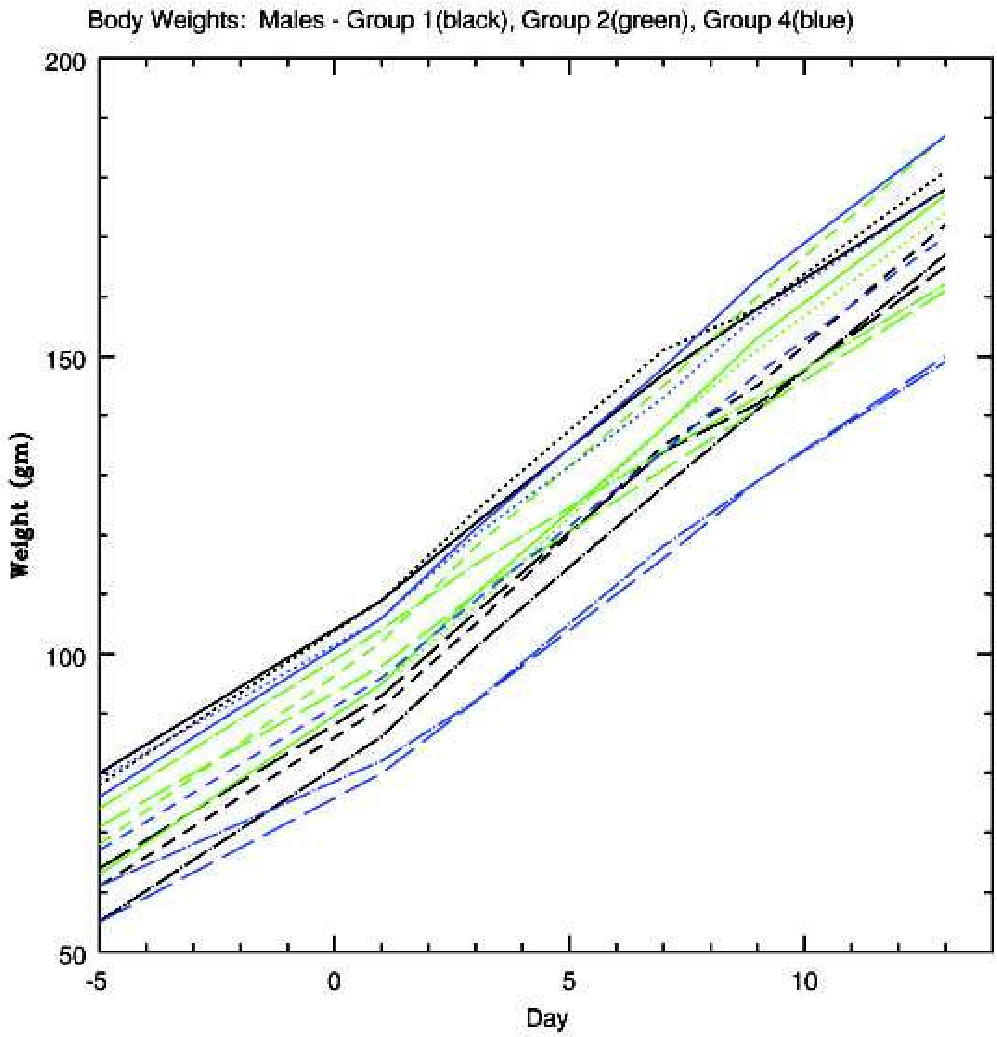

Figure 4b – Body weights of individual males of Group 2 against those of Fig. 4a

Fig. 4c similarly shows Group 3 (red curves), for male rats on the high-PAT-protein diet, together with the control groups of Fig. 4a. Here two red curves (short-dashed, dot-dashed) veer downwards from Day 1 (beginning of the test diet), while a third red curve (long-dashed) turns downwards with respect to neighbouring curves from Day 9.

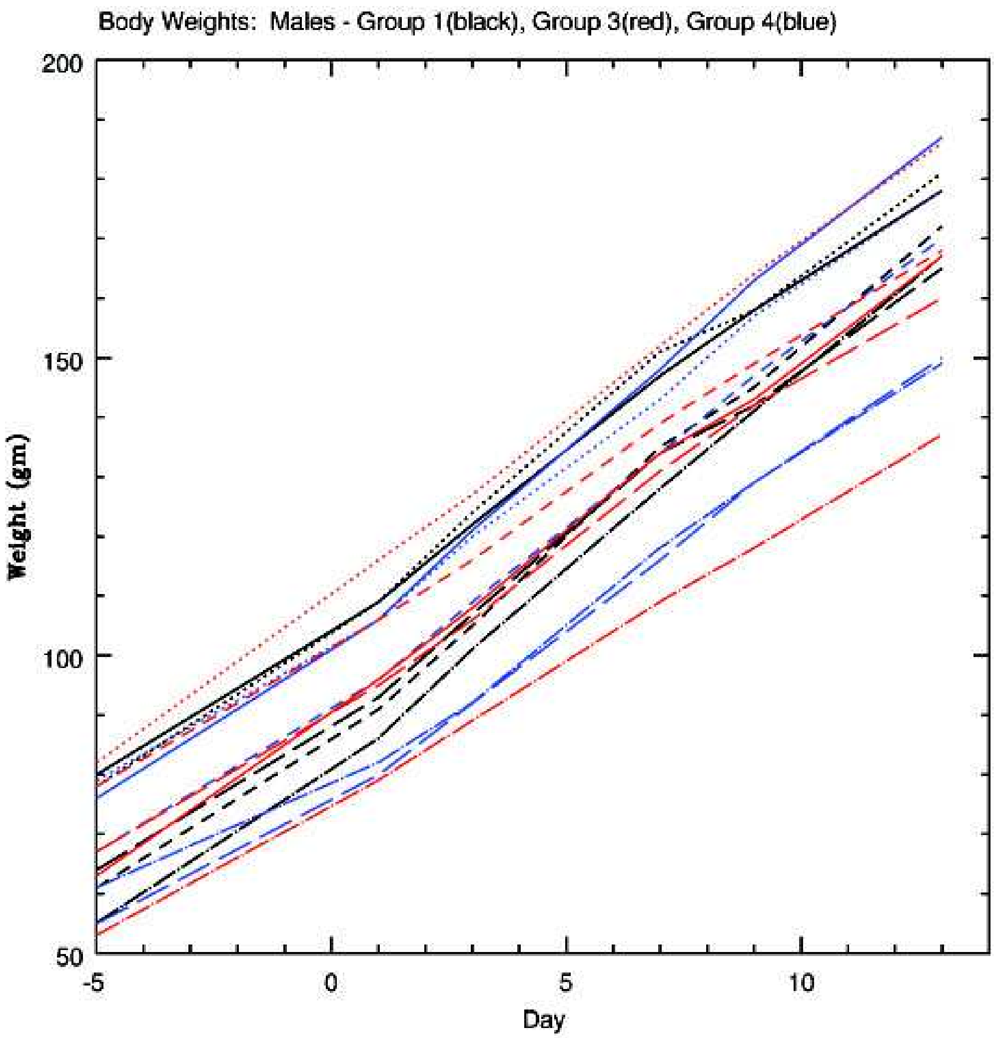

Figure 4c – Body weights of individual males of Group 3 against those of Fig. 4a

Figs. 5a-c are similar diagrams for females.

Fig. 5a plots the body weights of female rats in the control groups, Group 1 (black curves, normal diet) and Group 4 (blue curves, soya-protein diet). The curves tend to be parallel near the beginning and the end, although (as in the case of male rats), a temporary downturn occurs between Days 7 and 9 for two curves (blue long-dashed and black dot-dashed); and an upturn is seen during this interval in the blue solid curve. All curves then appear normal, except that the blue long-dashed curve rises more steeply than any other.

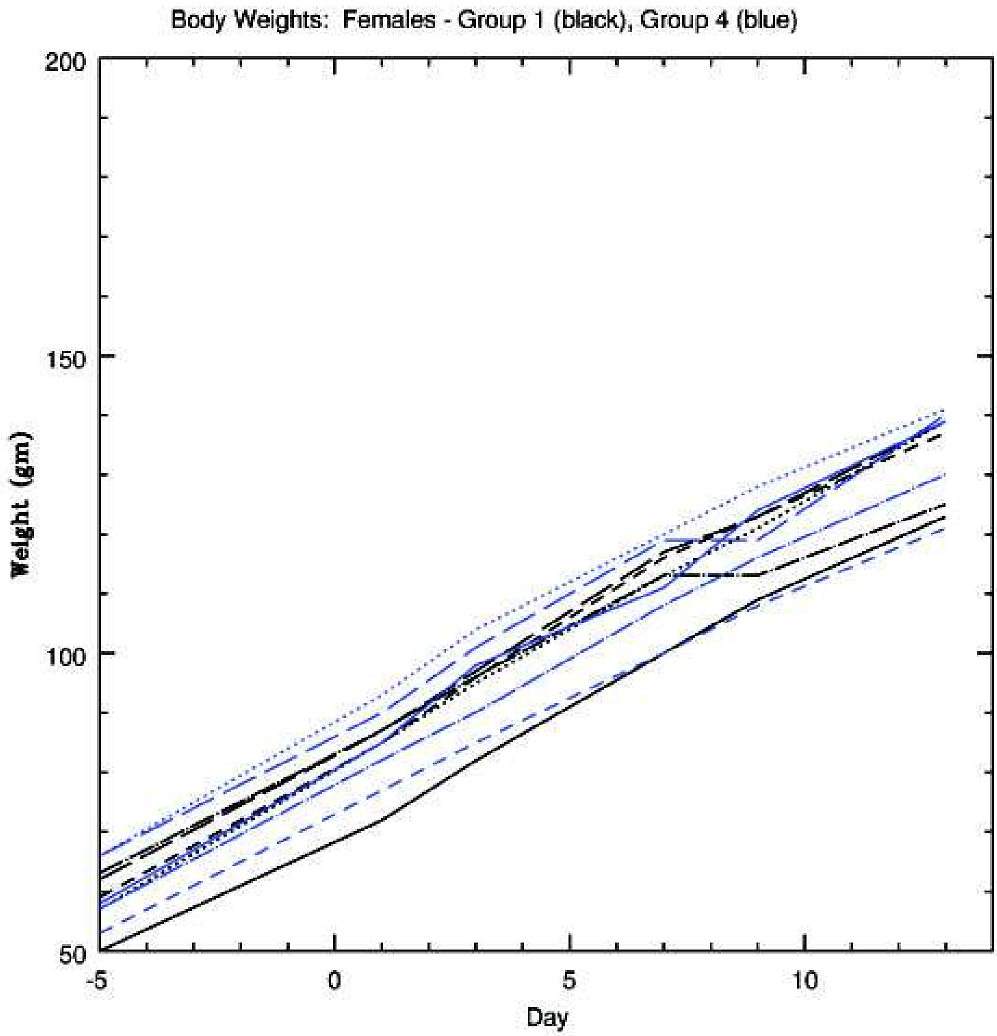

Figure 5a – Body Weights of female rats in control groups

Fig. 5b shows the females from Group 2 (green curves, low-PAT-protein diet) together with the control groups of Fig. 5a. The long-dashed and solid green curves turn downwards after Day 9, crossing other curves. (Although a third green curve [dot-dashed] crosses other curves on a downward trend, this tendency is present from the beginning and may not be caused by the diet.)

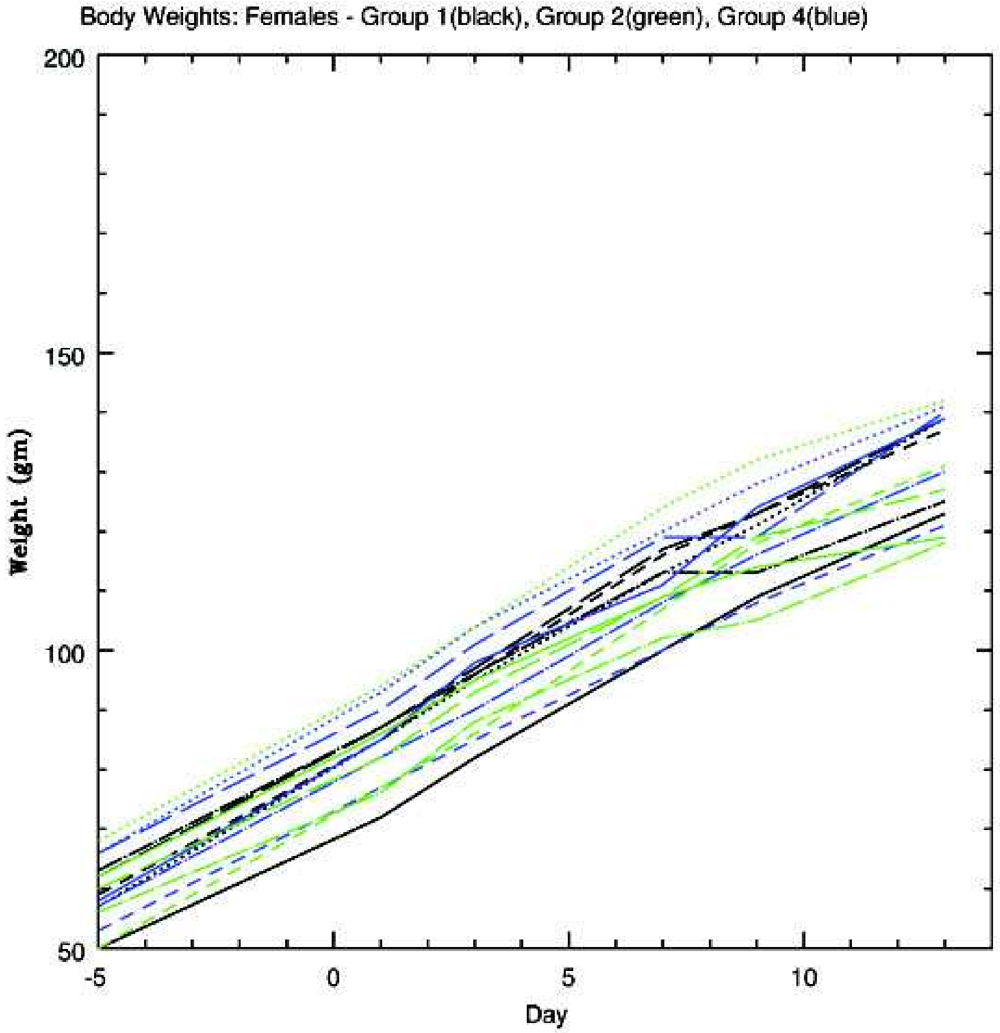

Figure 5b – Body weights of female rats of Group 3 against those of Fig. 5a

Fig. 5c similarly plots the females of Group 3 (red curves, high-PAT-protein diet) superimposed on Fig. 5a. The red dot-dashed curve crosses other curves in a downward turn from Day 9.

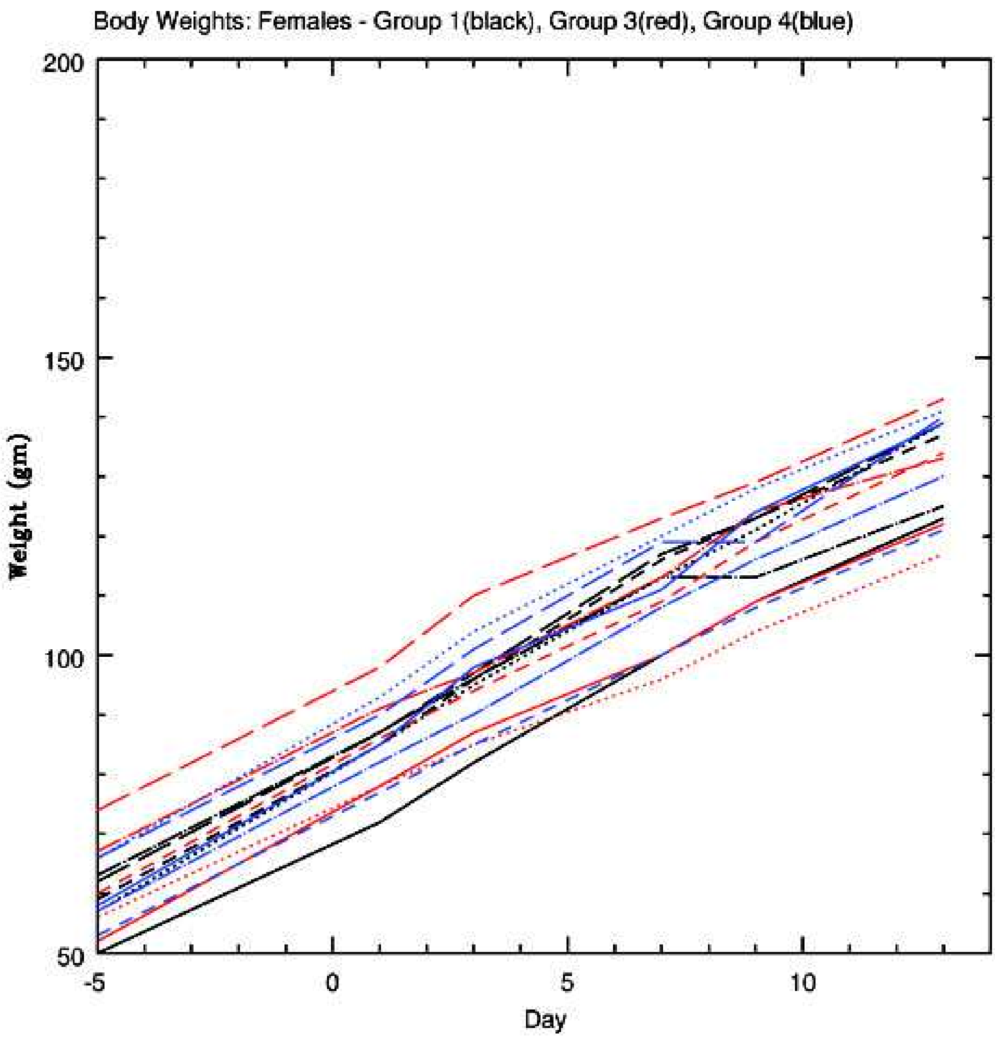

Figure 5c – Body weights of females of Group 3 superimposed on Fig. 5a

In summary, we note that, during the last interval of the experiment, 2 males and 2 females on the low-PAT-protein diet were not gaining weight as rapidly as other rats in the same group or in the two control groups. Of the rats on the high-PAT-protein diet, 3 males and one female were falling behind in weight gain during the last interval. While these data are not conclusive because too few animals were studied over too short a time, there is a suggestion that some individuals were not thriving on the diets that included PAT protein.

Alternatively, the slopes may be examined in tabular form. Table 1 lists the overall slopes for individuals and also for averages within groups, between Days 1 and 13. For the males eating a small amount of PAT-protein (Group 2), average weight-gain per day was the same as that of control Group 4, although it was slightly less than that for control Group 1. For females in Group 2, the average was distinctly below that for the two control groups. For both males and females in Group 3, which consumed the large amount of PAT-protein, average weight-gain per day was distinctly lower than for either control group.

TABLE 1. Weight-gain (gm) per day, between Day 1 and Day 13

	Males	Females	Ave. (males)	Ave. (females)
Group 1	5.8, 6.0, 6.8, 6.0, 6.8	4.3, 4.5, 4.3, 4.3, 3.2	6.3	4.1
Group 2	6.8, 6.6, 7.1, 5.3, 4.8	2.8, 4.0, 4.5, 3.8, 3.5	6.1	3.7
Group 3	5.9, 5.8, 5.2, 5.4, 4.8	3.7, 3.3, 4.0, 3.8, 3.5	5.4	3.6
Group 4	6.8, 6.0, 6.2, 5.8, 5.6	4.5, 4.0, 3.7, 4.2, 4.0	6.1	4.1

3.4 Re-examination of food consumption

Figs. 6a and 6b present the average food consumption per day for each of the four groups. Except for one of the line-styles and the introduction of colour, these curves are identical to those on pp. 37 and 38 of the study. Noteworthy in Fig. 6a, for males, is the steep increase in the food intake of Group 3, eating the high dose of PAT-protein, during the last stretch of the experiment. The peak at week 1.0 for this group, although not significant in itself, may become so in the light of Fig. 6b, which also displays an exaggerated peak at this date for females eating the high dose of PAT-protein. There, too, a rapid rise in food consumption is evident in the last interval of the study.

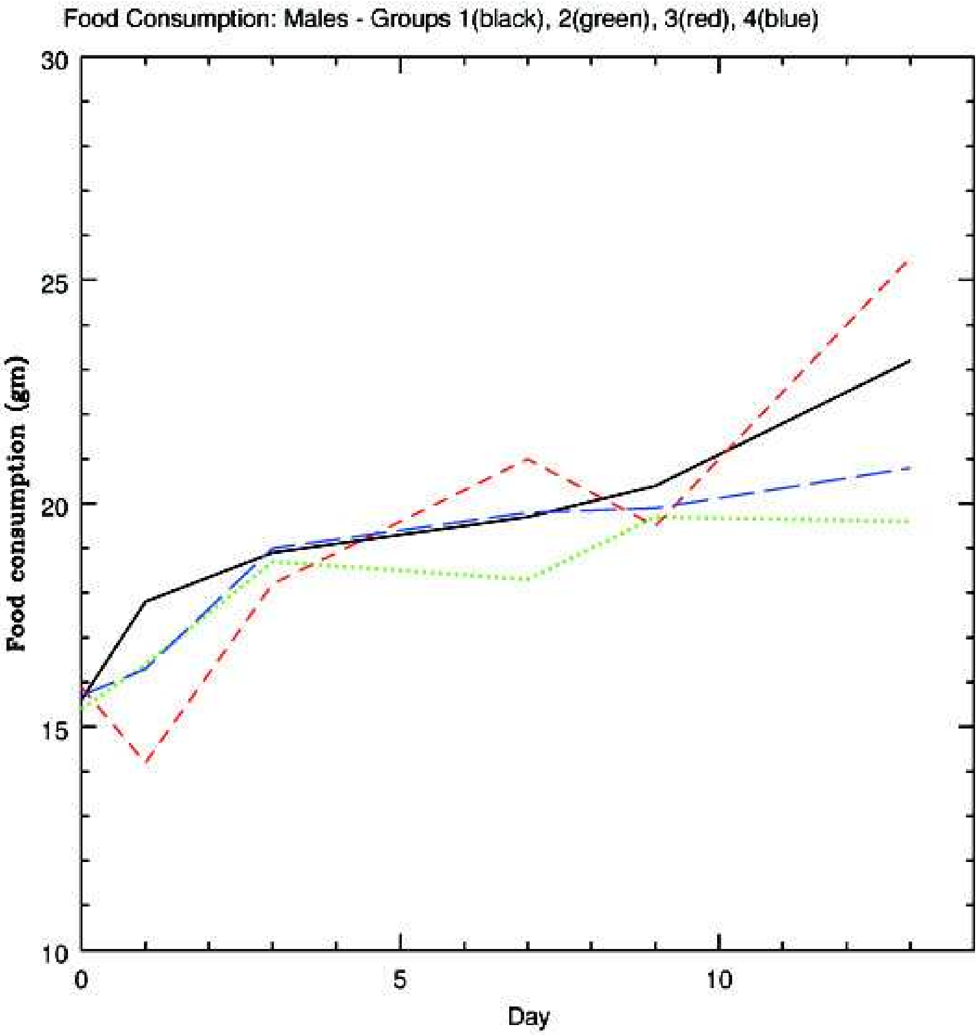

Figure 6a – Average food consumption per day for males

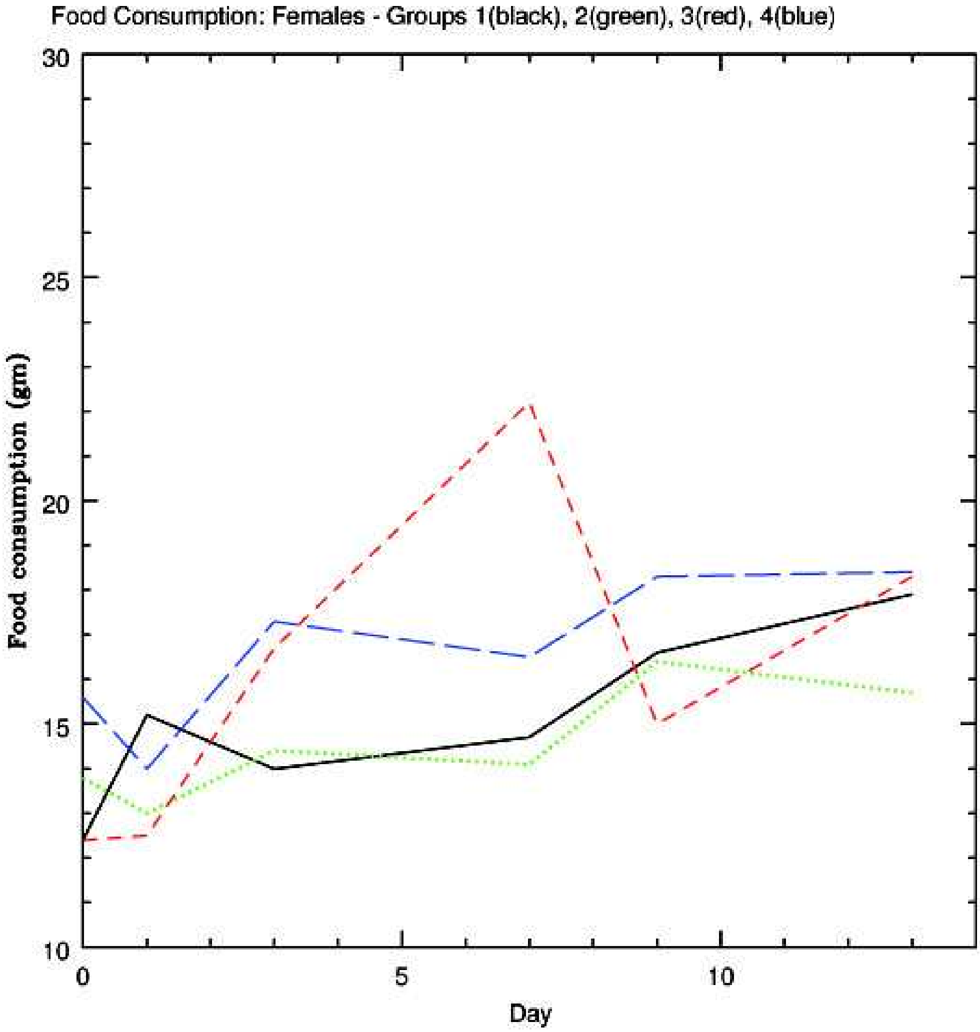

Figure 6b – Average food consumption per day for females

Since food consumption will naturally vary with the weight of an animal, the same data have been presented in terms of food consumed per gramme of body weight per day, in Figs. 4c, d on pp. 41, 42 of the study. Those curves produce the same features as were noted in the preceding pair of figures, and so they have not been reproduced here.

Although the table of contents of the study claims to present data on food consumption for individual animals on p.81 and relative food consumption (relative to body weight) on p. 85, these pages contain only repetitions of the data averaged over each group. Attempts have been made to obtain this information from both the Biotechnology Group of the Department of the Environment, Transport and Regions, and from Aventis; but both organisations say they do not have these data. It is possible that the data have never existed, because all the rats in any given group were housed together in one cage and the monitoring of individual feed intakes may not have been attempted.

3.5 Conclusions on the rat study

Detailed examination of the data does not bear out the stated conclusions of the study. No definitive conclusions can be drawn about weight gain or food consumption, because the numbers of individuals in the groups were too small and the study was terminated too soon. Nevertheless, there are indications that some animals may have been affected by the consumption of the PAT protein. The slow rates of gain in weight of several of the animals eating PAT-protein indicate that they are not thriving as well as the rats in the control groups. Unusual patterns in the average food intake of animals consuming PAT-protein also suggests that the diet does not suit them.

4. STRAY CATTLE DID NOT EAT GM MAIZE

The following press release was issued by the Ministry of Agriculture, Fisheries and Food on November 10, 2000:

'Damage To Gm Maize National List Trial Site'

'The NIAB (National Institute of Agricultural Biotechnology) have notified MAFF of damage to a national list trial of GM forage maize taking place in Somerset. The damage was caused by cattle straying onto the site in October. There is no evidence that the cattle ate any of the maize.

'Sheridan - the maize in question - has full approval under European GM legislation to be marketed for both animal and human food use. The undamaged maize at the site has since been harvested.

'Notes to Editors

…

'2. Sheridan is a genetically modified forage maize that contains the same genetic construct (conferring herbicide tolerance) as Chardon LL. Sheridan therefore has a full part C marketing consent under 90/220/EEC, including use as animal feed, as well as approval under the Novel Foods Regulation.

'3. NIAB is MAFF's National List trials co-ordinator. …'

It is interesting to note that the cattle did not wish to eat any of the maize.

5. ANECDOTAL EVIDENCE ON ANIMALS' RESPONSE TO GENETICALLY MODIFIED FEED

5.1 'When the Corn Hits the Fan'

American journalist Steven Sprinkel wrote an article with the above title in an ACRES, USA Special Report dated 19 September, 1999 (reproduced on the Natural Law Party Wessex website). The following excerpt is relevant to this section.

'After four months of retrieving anecdotes from Kansas to Wisconsin, I think its high time to sample the producer community more thoroughly to see how many stories there are out there. About the hogs that wouldn't eat the ration when the GMO crops were included. About the farmer who said "Well, if you want your cattle to go off their feed, just switch them out to a GMO silage." About the farmer who said that his cattle broke through an old fence and ate down the non-GMO hybrids but wouldn't touch the Round-up ready corn, and as a matter of fact "They had to walk through the GMOs to get to the Pioneer 3477 on the other side." About the cattleman who saw the weight-gain of his cattle fall off when he switched over to GMO sources. About the organic farmer with a terrible deer problem on his soybeans, and when he drives out at night there are forty of them mowing down his tofu beans while across the road there isn't one doe eating on the Round-up Readies. About the raccoons romping by the dozen in the organic corn, while down the road there isn't one ear that's been touched in the Bt fields. Even the mice will move on down the line if given an alternative to these "crops". What is it that they know instinctively that most of us ignore?'

5.2 Other incidents of cattle refusing to eat Bt maize

Various scientists working actively with the farming community in the United States have reported difficulties with the feeding of GM maize to cattle. In April 2000, one of them (who has asked to remain anonymous) sent the following information.

There have been dozens of such reports over the last two years. Generally, the reports are concerned with Bt maize. Many farmers feed maize to their cattle just as it grows, without mixing in other feedstuffs. Typical reports are that the farmer buys a new shipment of maize, which his cattle either refuse to eat or eat with reduced consumption. Upon making enquiries, he discovers that the maize is a genetically modified variety. When he replaces it with a non-modified maize, the cattle start eating again.

5.3 Scientific evidence for animal preferences

Although it may be difficult to credit animals with the ability to distinguish between GM and non-GM feed, this anecdotal evidence is supported by scientific evidence that they can indeed distinguish between organically- and non-organically-produced feed; moreover, they have a definite preference for the former. Woese *et al.* made a review of the relevant literature and concluded that 'animals distinguish between the foods on offer from the various agricultural systems and almost exclusively prefer organic produce. The reason for this preference is not known.' (Woese, K., Lange, D., Boess, C. and Werner Boel, K., 1997, *Journal of Science of Food and Agriculture*, vol. 74, p. 281, as quoted *in Organic Farming, Food and Human Health*, 2001, Soil Association, p.49)

6. CONCLUSIONS OF THIS REPORT

Two animal-feeding tests were offered to prove the safety of Chardon LL, but both were performed on animals with digestive systems that function very differently from that of cattle. In the case of the rat experiment, only the isolated PAT protein was fed and not the whole plant, which would be given to cattle. Re-analysis of experiments on chickens and on rats suggest, contrary to the official conclusions, that at least some individuals do not gain weight as rapidly as they should when given a diet including genetically modified feed. Furthermore, there appear to be irregularities in the feeding habits of at least some animals given GM feed. In the experiment on chickens, mortality was twice as high amongst those fed the GM maize as amongst those fed non-GM maize.

A significant amount of scientific evidence on farm animals indicates that they prefer organically produced feed to conventionally produced feed; and a substantial amount of anecdotal evidence on both farm animals and wild animals indicates that they will not choose to eat genetically modified feed if given a choice, and, if choice is not available, they do not thrive on GM feed.

On the basis of the evidence available, there is reason to be concerned that the genetically modified maize Chardon LL may have adverse effects on cattle.