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Serum Protein Changes in Cafeteria Mice Induced by Starvation

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Serum protein changes in cafeteria and control mice induced by starvation have been studied. Animals were subjected to food deprivation at 0, 3, 6, 9, 12, 18, 24 or 36 hours. Results show a more stabilized situation in cafeteria mice than controls particularly in protein metabolism. Serum protein composition changed very little during starvation, suggests a lower protein and amino acid catabolism induced by the high adaptation to consume lipids.

Key words: Serum proteins, Cafeteria mice, Starvation.

Serum proteins can be considered a significant index of overall protein status in the mammal, as they are synthetized depending on the actual protein liver rates (8). Their degradation depends closely on the metabolic and energetic status of the animal (5).

The proportion in which the different serum proteins can be found in a given physiological situation depends, thus, on their differential turnover rates. A higher proportion of albumin could be a consequence of lowered albumin degradation, higher synthesis or altered fluid compartimentation and/or blood vessel endothelium permeability (6, 9).

The present study aims to determine in mice the possible effects of both food deprivation and the availability of a protein and energy diet rich —as is the cafeteria diet— on the levels and proportion of serum proteins.

Materials and Methods

Thirty days of females OF-1 mice were used. The animals were kept in collective pulycarbonate bottomed cages with wood shavings as absorbing and bedding material. The cages were kept in an animal room with temperature (21-22°C), humidity (75-85%) and lighting cycle (on from 08.00 to 20.00 h) controlled environment. Two groups of animals were subjected to dietary treatments: a) controls, received a

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pelleted commercial diet (A01 from Panlab, Barcelona) plus tap water, and b) cafeteria, received the same diet supplemented with daily fresh offerings of excess cookies, pastry, bacon, roasted hazelnuts, Swiss cheese, liver pâte, candy, banana, chocolate and milk supplemented with a mineral and protein additive (10). The dietary treatment was continued for sixty days, when the mice attained the weights of 32 ± 1 g for controls and 41 ± 2 g for cafeteria animals; the weight of controls had already been stabilized as they were well into adulthood. Both dietary groups were subjected to 3, 6, 9, 12, 18, 24 or 36 h of food deprivation, which was accomplished by removing all food (water supply was maintained at all time) from their cages for these periods before their sacrifice, that took place at the beginning of a lighted period.

Blood was recovered in dried beakers following decapitation with guillotine, allowed to clot at 4°C for 30-60 min and centrifuged to obtain serum. The packed cell volume was also determined for each sample. Serum protein concentration was determined with the LOWRY method (4). Serum proteins were separated by means of unidirectional acetate strip electrophoresis (3) staining the bands with amido black (2). The electropherograms were evaluated through densitometry.

Statistical differences between the means were determined by using the Student's *t* test.

Results

The changes observed in packed cell volume and total serum proteins in mice fed either control, or cafeteria diets during food deprivation are presented in figure 1. Starvation resulted in a slightly and transient increase in serum proteins in cafeteria mice. Controls increased progressively up to 36 hours. The changes observed in the levels of serum proteins were actually

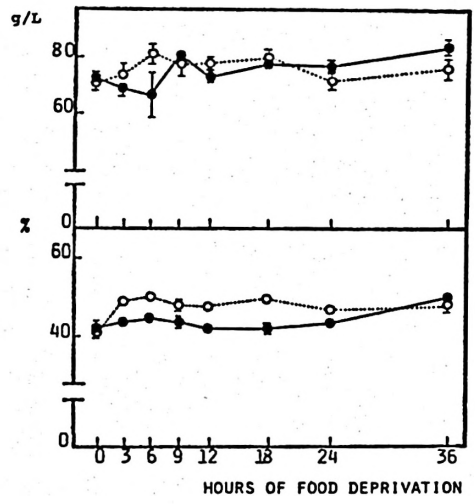

Fig. 1. *Serum protein (upper graph) and packed cell volume (lower graph) changes in controls (black circles) and cafeteria (open circles) of mice subjected to food deprivation.*
The values shown are the mean ± s.e.m. of 6 different animals. Statistical significance of the differences between means: Versus 0 time: * = P < 0.05; versus control diet: + = P < 0.05.

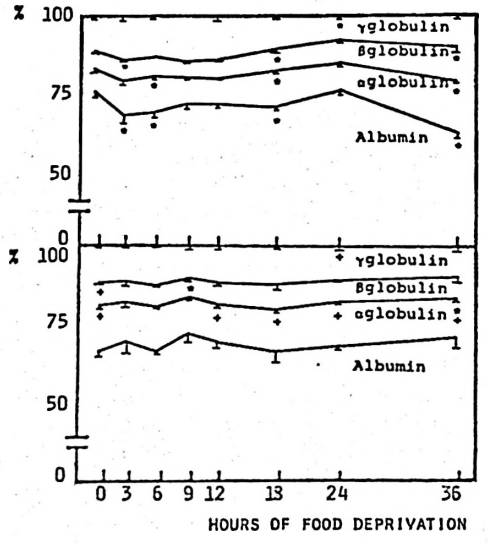

Fig. 2. *Serum proteins distribution (in additive %) in control (upper graph) or cafeteria (lower graph) mice subjected to food deprivation.*
The values shown are the mean ± s.e.m. of 6 different animals.

lower in cafeteria mice than in controls, whose levels decreased shortly after food deprivation. Packed cell volume was maintained in controls, increasing significantly after 36 hours of starvation. Cafeteria mice showed a raised packed cell volume with respect to controls after 3 hours of starvation, maintaining this situation and differences up to long term food deprivation.

The distribution of serum proteins in groups separated through electrophoresis are shown in figure 2 for both controls and cafeteria mice. The patterns showed a considerable predominance of albumin, with decreasing albumin and γ-globulin, as well as increasing α- and β-globulin shares in controls with starvation. On the other side, cafeteria mice showed a much more uniform pattern, with practically no changes during the starvation period studied.

Discussion

The data shown suggest a much more stabilized situation in cafeteria mice as to overall protein metabolism and, particularly as to serum protein composition, which actually changed very little with starvation, despite its 36 h lenght, which is considerable for mice. The initial protein concentrations observed in mice serum were coincident for both dietary groups, in clear disagreement with the situation encountered in rats, which had higher plasma protein concentration with the cafeteria diet (7). This trend, however, became apparent when starvation was begun, as cafeteria mice were more able to maintain their serum protein levels than controls. This was not really a consequence of hemodilution, as the packed cell volume actually first increased and the remained constant, but a probable consequence of changing turnover rates for these proteins. The significant drop observed in short term food deprivation in controls (but not in cafeteria mice) suggests a change in the compartmentation of serum proteins due to altered permeability of the capillary endothelium.

The alteration of the serum protein pattern observed in controls is in agreements with an increased utilization or distribution into a larger compartment of these proteins. The larger units, sea are some globulins, tend to increase their share in detriment of the smaller globulins and albumin. In addition, the synthesis of γ-globulins seems to be hampered by the generalized decrease in protein synthesis induced by starvation. Such alterations were not observed in cafeteria mice, probably due to their better maintained energetic homeostasis (1) and their diminished protein and amino acid catabolism induced by the high availability of fat and energy in the cafeteria diet (10).

Resumen

Se estudian los cambios producidos en situación de ayuno sobre los niveles y la distribución de las proteínas séricas en animales alimentados con una dieta de cafetería o una dieta control. Los resultados muestran una mayor estabilidad del metabolismo proteico en los animales de cafetería con respecto a los controles. La composición de las proteínas séricas no se ve prácticamente afectada durante el período de ayuno. Los resultados sugieren una atenuación del catabolismo proteico inducida por la elevada adaptación de estos animales al consumo de lípidos.

Palabras clave: Proteínas séricas, Ratón cafetería, Ayuno.

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