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Regulation of food intake in the goat

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SUMMARY

This thesis deals with the question whether blood constituents may act as a satiety signal in the control of food intake in a free-feeding ruminant species, viz. the goat. The emphasis is on the role of volatile fatty acids (VFA), since these agents are major energy sources in the ruminant.

After a general introduction in Chapter I, the effects of food intake under various conditions on the concentrations of blood constituents in systemic or hepatic portal blood are presented in Chapter II and III. Goats were prepared with permanent silastic jugular or portal vein catheters in order to collect blood samples with minimal disturbance of the animal. Blood samples were analysed for plasma insulin, glucagon and growth hormone by radioimmunoassay, for blood glucose and for VFA, the latter being isolated by a very rapid vacuum micro-distillation prior to gas chromatographic determination.

In goats fed twice daily food consumption resulted in very rapid and large increases of peripheral acetate, propionate, n-butyrate and 3-methylbutyrate, whereas only minor changes, if any, were observed for the other branched-chain VFA and n-valerate. Acetate usually rose within 20 min after food was offered whereas propionate, n-butyrate and 3-methylbutyrate rose within 10 min. In the portal vein the concentrations of acetate, propionate and n-butyrate fluctuated in parallel with the VFA in peripheral blood, although both the concentrations and the changes were much greater. Small increases in concentrations of insulin and glucagon in response to food intake were observed. As a rule glucose declined in the initial hour after feeding and subsequently increased resulting in a more or less raised plateau (Chapter II).

In ad libitum-fed subjects blood sampling was done by external extension catheters, permitting sampling without disturbance of normal feeding behaviour. In this case no relation between spontaneous meals and the peripheral or portal VFA concentrations was observed. However, a meal elicited a clear increase of the insulin concentration. Glucagon also appeared to increase

during a meal, whereas growth hormone was significantly decreased after a meal. Glucose was not related to meals (Chapter III).

The above results cast doubt on the view that VFA are involved in meal patterning in free-feeding animals. However, in the literature concerning the influence of administration of VFA on food intake in ruminants there is much support for that view. In an attempt to resolve this dilemma, goats provided with a jugular catheter and in addition with either a rumen cannula or a hepatic portal catheter, were continually infused with VFA into the hepatic portal vein or the rumen, and the influence determined on food intake and especially on meal patterns. Jugular blood and rumen fluid samples were collected in order to compare the induced increments of VFA with the normal concentrations (Chapter IV, V and VI).

In Chapter IV the effects of intraportal or intraruminal infusions of VFA on peripheral concentrations of these acids are presented. This design also aimed at studying the role of VFA in the control of plasma insulin and glucagon; the results suggest that only rapid fluctuations of blood propionate or n-butyrate may contribute to the regulation of plasma insulin. Such a role of VFA is less likely for controlling plasma glucagon. Intraportal infusions of VFA affected neither total food intake, nor meal sizes or meal frequency when physiological rates were administered, so that it is concluded that portal or peripheral concentrations of VFA do not affect feeding behaviour in the goat under the conditions tested (Chapter V).

Chapter VI describes the experiment with intraruminal infusions in order to study whether receptors in the rumen wall and its venous drainage system are involved in eating. Propionate, n-butyrate, n-valerate or branched-chain VFA did not induce changes in feeding behaviour; acetate caused a depression but so slightly and inconsistent in spite of the high rumen fluid levels of acetate induced by the infusion, that it is suggested that the rumen fluid VFA concentrations do not play an important role in the control of feeding behaviour either.

The results of the experiments are discussed in each chapter and finally summarized and commented on in Chapter VII. It is concluded that fluctuations of VFA do not control feeding patterns in the free-feeding goat but the results suggest that insulin may act as a satiety signal.