

Cognitive performance and its relation to postprandial metabolic changes after ingestion of different macronutrients in the morning

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The effect of carbohydrate, protein and fat ingestion on simple as well as complex cognitive functions and the relation between the respective postprandial metabolic changes and changes in cognitive performance were studied in fifteen healthy male students. Subjects were tested in three sessions, separated by one week, for short-term changes in blood parameters, indirect calorimetry, subjective performance and different objective performance tasks using a repeated measures, counterbalanced crossover design. Measurements were made after an overnight fast before and hourly during 3 h after test meal ingestion. Test meals consisted of either pure carbohydrates, protein or fat and were served as isoenergetic (1670 kJ) spoonable creams with similar sensory properties. Most aspects of subjective performance did not differ between test meals. For all objective tasks, however, postprandial cognitive performance was best after fat ingestion concomitant to an almost constant glucose metabolism and constant metabolic activation state measured by the glucagon to insulin ratio. In contrast, carbohydrate as well as protein ingestion resulted in lower overall cognitive performance, both together with partly marked changes ($P < 0.001$) in glucose metabolism and metabolic activation. They also differently affected specific cognitive functions ($P < 0.05$) in relation to their specific effect on metabolism. Carbohydrate ingestion resulted in relatively better short-term memory and accuracy of tasks concomitant to low metabolic activation whereas protein ingestion in better attention and efficiency of tasks concomitant to higher metabolic activation. Our findings support the concept that good and stable cognitive performance is related to a balanced glucose metabolism and metabolic activation state.