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Carbohydrate and lipid composition of vegetables, and bioavailability assessed in a rat model: Impact of cultivation systems

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Introduction

Environmental as well as cultivation factors may greatly influence the chemical composition of plants. Main factors affecting chemical composition of foodstuff are level and type of fertilizer (conventional and organic cultivation systems), location or soil type, and year of harvest. Organic foods are defined as products, which are produced under controlled cultivation conditions characterized by the absence of synthetic fertilizers and very restricted use of pesticides.

Materials and Methods

Potatoes, carrots, peas, green kale, apple, and rapeseed were grown by three different cultivation strategies, i.e. conventional (CON), organic (ORG) or semi-organic (ORG+) farming system. The ingredients were mixed with a standard synthetic mixture and were formulated to meet the NRC requirements for rats and used in a balance experiments for measuring the bioavailability of the ingredients.

Table 1. Chemical composition of the carbohydrate and lipid fraction of vegetables grown at different cultivation systems

Ingredients	Apple	Carrot	Kale	Pea	Potato
Carbohydrate, g/kg DM					
Sucrose	171	333	15	50	1
Total sugars	702	523	104	78	32
Starch	-	-	23	232	801
NSP	131	208	422	287	87
Dietary fibre	148	215	468	297	87
Lipids					
Total fat, g/kg DM	8	10	54	41	2
Palmitic 16:0, % of fat	22	32	18	14	40
Oleic 18:0, % of fat	12	6	3	30	4
Linoleic 18:2, % of fat	45	50	29	46	31
Linolenic 18:3w3, % of fat	7	3	46	7	5

Results and Discussion

- Carbohydrate and lignin were the predominantly dietary constituents with values from 584 g/kg DM in kale to 910 g/kg DM in potatoe (Table 1).
- The bulk of disaccharides and starch is to a large extent digested in the small intestine.
- Dietary fibre (NSP+lignin) pass to the large intestine where some fermentation takes place. Adequate intake of dietary fibre is accepted as having health benefit by increasing the fecal bulking (illustrated in Figure 1).
- Triacylglycerol was the major lipid class in pea with 82 % of total fatty acids in contrast to apple with only 35 % of fatty acids in the ether extract.
- The essential fatty acids linoleic (C18:2) and linolenic (C18:3w3) contribute with the largest fraction in all the vegetables (Table 1). In contrast oleic acid (C18:1) is the prominent fatty acid in rapeseed oil (Table 2).
- Cultivation system had minor impact on the chemical composition and bioavailability of the plant ingredients, when assessed in the rat model.
- However, the fatty acid composition differed between cultivation system for the rapeseed oil and this affected the change in some biomarkers (Lauridsen et al. 2008).

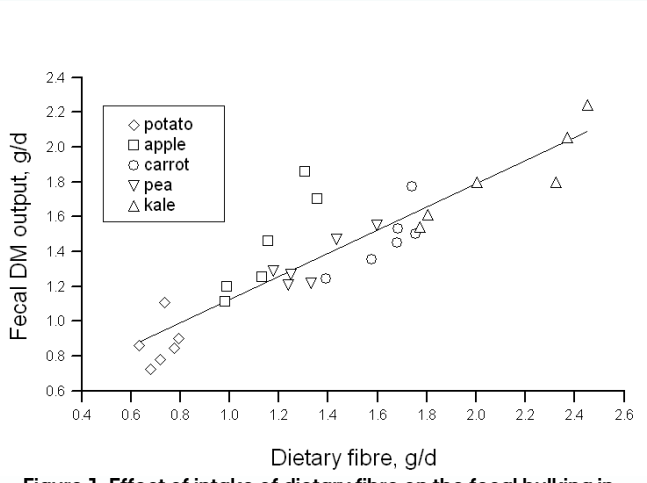

Figure 1. Effect of intake of dietary fibre on the fecal bulking in rats fed diets containing the listed vegetables. All rats had an equal amount of consumed feed daily.

Table 2. Fatty acid composition of the rapeseed oil from the three cultivation systems

Cultivation system	CON	ORG	ORG+
Fatty acid, % of total lipid			
Palmitic, 16:0	4.4	4.3	3.8
Oleic, 18:1	65.4	64.1	74.3
Linoleic, 18:2	17.6	19.3	8.7
Linolinic, 18:3w3	8.6	8.3	9.1

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