

## General introduction

Childhood obesity has risen dramatically during the last decades in Europe (Lobstein & Frelut, 2003; Lobstein et al., 2004). In Copenhagen the percentage of overweight 6 – 8 year old children has increased from approx. 2% in 1947 to 15% among boys and 21% among girls in 2007 (Pearson et al., 2005). During the same period obesity has risen from <0.1% among 6-8 years old boys and approx 0.2% among 6-8 years old girls to 5 and 4 % respectively in 2007. This is critical since overweight and obesity among children affects the physical, psychological and social quality of their life. Overweight children also have higher risk of being overweight as adults (Whitaker et al., 1997). Action is therefore required to change this trend and intervention practises may be effective during early childhood where the child forms its food acceptance patterns and is highly influenced by its environment.

Early infancy is characterised as a sensitive period where infants learn about foods and eating (Cashdan, 1994; Cashdan, 1998; Beauchamp & Mennella, 1998). During this period it is assumed that infants easily accept new foods and flavours, and learn about the family's food environment. They become familiar with safe foods (Kalat & Rozin, 1973) and learn about the flavours that dominate their food culture. To optimise this learning it appears to be vital that infants are exposed to a great range of flavours and foods from early on. These first experiences modify the innate genetic predispositions to prefer sweet tasting foods, and reject unfamiliar or bitter (potentially toxic) foods (Birch, 2002).

Preference learning is established through repeated exposure to foods and flavours. This learning begins *in utero* where the foetus is exposed to dietary flavour cues originating from the maternal diet (Hepper, 1995; Schaal et al., 2000), and continues into the milk feeding period. Breast-fed infants seem to learn from dietary flavour cues transmitted via mother's milk (Mennella et al., 2001), and formula-fed infants appear to have increased acceptance of foods characterised by flavour notes similar to their formula milk (Mennella & Beauchamp, 2002). Exposure to dietary flavour compounds may thus facilitate the transition between the early feeding sources. Acceptance learning from exposure to flavour compounds via mother's milk has, however, been shown for very few foods and compounds, and requires further exploration.

The overall aim of this thesis was to investigate infant exposure to volatiles during the exclusive milk feeding period with focus on (dietary) flavour compounds in mother's milk and infant formulas. Infants' learning from flavour exposure in mother's milk and possible differences to formula-fed infants was also investigated. The following questions were examined:

- Does transfer of dietary flavour compounds into mother's milk depend on their molecular properties, and what is the transfer degree into mother's milk (paper I)?
- Which compounds can be identified in mother's milk and infant milk formulas? In what respect do the two feeding sources differ (paper II)?

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- Do infants learn to accept a dietary flavour compound through repeated exposure via mother's milk? Does breastfeeding *per se* enhance infants' acceptance novel compounds (paper III)?
- How does acceptance of a dietary flavour compound evolve over repeated exposures via solid food? Does previous exposure via mother's milk affect this preference (paper III)?

During this project I have experienced great interest in my studies and for the area in general. A detailed review of the existing literature is provided to give an overview for the uninitiated reader of the many factors that may shape infants food acceptance patterns during infancy and young childhood. The review is divided into six subsections covering the ontogeny of flavour perception and its function in term infants, exposure to volatiles in milk sources, a discussion of potential determinants of transfer of compounds into mother's milk, a review of preference learning, and a short review of weaning strategies. The literature review rounds off with research questions and objectives for the experimental work in this PhD. Chapter 2 concerns the methods applied in the experimental work, which is presented in chapter 3 - 5. A summary of the study results is given in chapter 6. Chapter 7 contains a summarising discussion that is followed by conclusions and future perspectives in chapter 8. The flow in the experimental work presented in this thesis is presented in figure 1.

The experimental work focuses on exposure to volatile compounds during the milk feeding period, and a possible learning from flavour cues via mother's milk. The introduction therefore focuses on volatile profiles in milk sources, olfactory learning and its implications. Taste components and experiences are mentioned shortly.

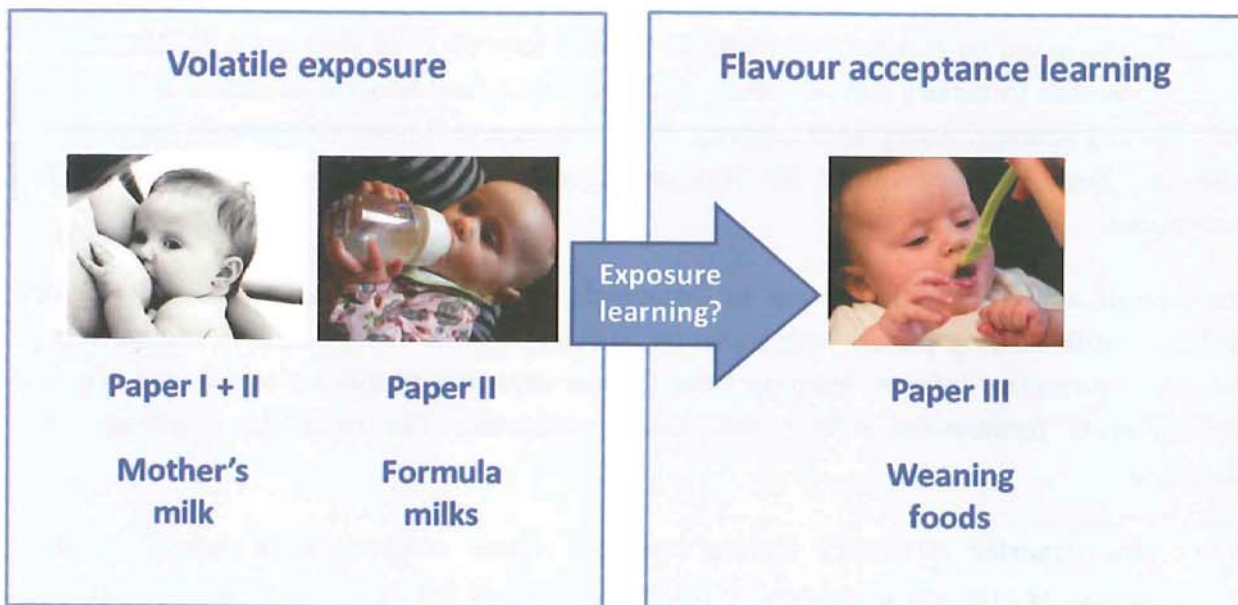


Figure 1. Relationship between the papers included in the thesis.

Finally, a few terms should be pointed out before reading the thesis. The concepts acceptance and preference are easily – and often – mixed. In this thesis *preference* is used to describe when one food or compound is selected over another. Preference learning refers to when the infant learns to prefer one odour or food over another, which does not always correspond with high liking of the substance. *Acceptance* is defined as taking willingly something that is offered in the Oxford English Dictionary, and is used in this thesis to describe when a food is eaten with enjoyment. I would also like to stress that the term *formula-fed* covers infants fed formulas exclusively after birth (or exclusively a few weeks after birth). Likewise the term *breast-fed* refers to exclusively breast-fed infants.