

**1) Renseignements administratifs sur la direction de thèse<sup>1</sup> (1 page maximum) :**

**Directeur de thèse HDR :**

Nom : TOURNIER

Prénom : Carole

**2) Descriptif du projet de thèse (devra inclure les rubriques suivantes) :**

Nom et label de l'unité de recherche (ainsi que l'équipe interne s'il y a lieu) :

- Unité UMR 1324 **Centre des Sciences du Goût et de l'Alimentation (CSGA)**, Plateforme ChemoSens, INRAE 17 rue Sully 21000 Dijon, France

Une partie des travaux de thèse seront réalisés à l'Université de Wageningen (Wageningen Campus I Building 124 (Helix) AFSG, P.O. Box 17, NL-6700 AA Wageningen (Pays-Bas)) dans le laboratoire du professeur Ciaran Forde (**Wageningen University and Research Sensory Science and Eating Behavior, Division of Human Nutrition and Health**, [ciaran.forde@wur.nl](mailto:ciaran.forde@wur.nl), +31 317487120), dans le cadre d'une convention de co-tutelle entre l'université de Bourgogne et l'université de Wageningen (qui sera mise en place en amont du démarrage de la thèse)

- Nom du directeur de thèse et du co-directeur s'il y a lieu : **Carole Tournier (INRAE, CSGA ; Directrice 100 %)**
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**Context**

Eating behaviour develop during childhood, shaping long-term food choice and dietary habits, which underpin optimum growth and health (Tournier and Forde, 2023). The development of dentition and Food Oral Processing (FOP) skills during childhood are of major importance in the establishment of eating behaviour. Recent observations of children during videotaped meals reported large variability among children in their eating behaviour, with the description of an "obesogenic" style characterized by fast eating rate, larger average bite size, reduced chews per bite and a shorter oro-sensory exposure time (Fogel et al. 2017b). Besides, faster eating rates was associated with higher energy intake within an *ad libitum* meal: children who eat faster consuming up to 75% more energy within the same test-meal, compared to children who ate at a slower rate (Fogel et al. 2017a). Observed differences in eating behaviour have been further associated with more rapid weight gain, higher BMI<sub>z</sub> scores and increased adiposity among children that exhibit this obesogenic eating style (Forde, Fogel, and McCrickerd 2019). Therefore differences in the way children orally process their food during meals is one possible mechanism behind overweight and obesity in later childhood and adolescence. Between ages 5-12 years, children have mixed dental status as they transition from child to adult teeth. Whether child eating rate is associated with their chewing ability or dental status has been poorly studied to date (Schwartz and al., 2021).

Food texture and structure can directly influence both oral processing, eating rate and *ad libitum* food intake (Bolhuis and Forde, 2020). Food texture can also impact the

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<sup>1</sup> ATTENTION : selon l'article 16 de l'arrêté du 25 mai 2016, le total d'encadrants ne peut pas dépasser 2, sauf si l'un des encadrants appartient au monde socio-économique, qui peut venir en sus, ou en cas de co-tutelle; Le décompte des co-encadrements se fera au prorata du nombre d'encadrants : 1 pour 1 encadrant, ½ pour deux encadrants.

transformation of food into a swallowable bolus (Tournier et al., 2017; Goh and al., 2021), and influence the release of flavour (aroma and taste) compounds in the oral cavity (Salles et al., 2011 ; Repoux et al., 2012) and sensory perception (Devezeaux de Lavergne et al., 2016). These different impacts of food texture on eating behaviour, energy intake and flavour compounds release have been studied independently in literature and mainly in adult populations. To the best of our knowledge, few studies have explored the effect of food texture modification on child oral processing, eating behaviour and sensory perception.

## **Project**

The objective of the PhD project will be to assess how modifications of foods texture (from semi-solid to solid) independently of its composition and of other sensory dimensions, affect children oral processing behaviour, bolus formation, temporal aroma compounds release and sensory perception. In a second step we will compare how food texture modifications influence a child's eating rate, and *ad libitum* energy intake as a function of individual differences in eating rate and dentition. The hypotheses behind the work are the following:

- Compared to slow eaters, faster eaters have reduced chewing activity, reduced food break down in the oral cavity, reduce bolus surface area and aroma compounds release and thus decreased overall sensory intensity and temporal changes in perception during consumption.
- Providing more textured food will slow down eating rate, increase oro-sensory exposure, and lead to decreased *ad libitum* energy intake.
- Child dental status (number of teeth and occlusal contacts) and efficient chewing skills will influence different aspects of food oral processing/eating rate, *in vivo* aroma compounds release and energy intake within a meal.

## **Provisional calendar:**

### **Year 1 :**

- Bibliographical research on the subject
- Writing and submission of an ethical file
- **Study 1 (CSGA): study of the link between children dentition, chewing efficiency, eating rate and food bolus properties for two products varying in texture properties**
  - o Recruitment of a representative sample of school age children undergoing dental transition (5-12 years).
  - o Evaluation of their dentition, chewing efficiency and habitual eating rate
  - o Food bolus collection and characterization (granulometry, saliva uptake, bolus surface area) as it relates to observed differences in oral processing behaviour (average eating rate, bite size, chews *per* bite and oro-sensory exposure time).
  - o Preparation of results for peer review publication (Paper 1).

### **Year 2: Study 2 (CSGA/WUR): Study of the impact of food texture and individual eating rate on *in vivo* aroma compounds release and sensory perception**

- o Methodological development for an age appropriate *in vivo* aroma compounds release and sensory temporal measurements with children (5-12 years)
- o Assessments of aroma compounds release as function of food texture, bolus properties and child eating rate
- o Preparation of results for peer review (Paper 2).

### **Year 3 :**

- **Study 3 (WUR): Study the effect of food texture modification in moderating child eating rate and *ad libitum* energy intake**
  - o Recruitment of a representative sample of school age children undergoing dental transition (5-12 years).
  - o Development of two texture conditions (fast vs slow) to test the impact of food texture on eating rate and *ad libitum* energy intake.
  - o Running a cross-over *ad libitum* feeding trial with a representative sample of children.
  - o Preparation of results for peer review (Paper 3).
- Writing of PhD manuscript for submission to doctoral school and PhD referees.

**- Project funding – « financement acquis pour la partie Recherche » (montants acquis, type de contrat)**

- CSGA : Projet Carnot Qualiment 'Marelle' (PI : C Tournier, 120 685€, 2023-2026)
- WUR : TKI-Agri-Food (NL) LWV22150; 'RESTRUCTURE; Food Texture & Energy Intake (PI : CG Forde, €1.8mio, 2021 – 2025) and LWV22098; Metabolic Impact of Food Processing (Meta-Pro) (PI, CG Forde, €1.8mio, 2023-27).

**- Required knowledge and competences (Connaissances et compétences requises) :**

The candidate must be a graduate of a Master's degree in Food Science, Consumer Science or Physiology. Moreover he/she must:

- Be favourable with an abroad experience in an international context (France and the Netherlands)
- Have a good level of expression (oral and written) both in French and in English
- Have experience for working or contact with children
- Statistical knowledge and proficiency in statistical analysis software (R, SPSS, SAS...)
- Experience with multidisciplinary approaches would be a plus

**Résumé en français et anglais (limité chacun à 1800 caractères)**

**Abstract:** Eating behaviour develop during childhood, shaping long-term food choice and dietary habits, which underpin optimum growth and health. The development of dentition and Food Oral Processing (FOP) skills during childhood are of major importance in the establishment of eating behaviour. Eating style characterised as fast eating rate (limited chewing, poor oral sensory exposure) has been identified as a factor of increased *ad libitum* intake, associated with children weight status. Moreover, previous studies with adults showed that changes in food textures are able to slow down eating rate and reduce total food intake. This suggest that changing food texture could be a lever to decrease intake during a meal in children, despite they have been poorly addressed in this population so far. Besides, FOP has an impact on the dynamic formation of food bolus, the release of aroma compounds stimuli and thus in sensory perception, that need to be considered to understand eating experience. We will assess the role of the food texture on child mechanisms of sensory perception and food intake behaviour within a meal. The focus will be on individual differences in eating rate and dental status to better understand the impact this has on (i) food oral processing behaviour, (ii) the oral transformation of the food into a swallowable bolus, (iii) dynamic *in vivo* aroma compounds release and sensory perception and (iv) *ad libitum* energy intake during a meal.

The proposed work will involve working across two sites (CSGA, France and Wageningen University, the Netherlands) and will require developments for adapting available methodologies to the children population. The study will result in the development and validation of new techniques to track temporal sensory perception and aroma compounds release in school age children, and a first proof of principal study to test the efficacy of a food texture based intervention to modify child energy intake. Through this, the PhD project will

bring new knowledge in our understanding of the development of healthy eating behaviour by questioning the specific role of food texture.

### **Résumé :**

Le comportement alimentaire se développe pendant l'enfance, impacte les habitudes alimentaires à long termes et joue un rôle sur la croissance et la santé. Le développement de la dentition et des capacités masticatoires de l'enfant a un rôle dans l'établissement de ce comportement alimentaire. Lors de repas, un comportement ingestif caractérisé par une vitesse d'ingestion rapide (peu de mastication, temps de résidence en bouche faible) a été associé à une consommation énergétique accrue et à un statut pondéral plus important. Des études chez l'adulte ont par ailleurs montré que des modifications de la texture des aliments proposés pouvaient diminuer la vitesse d'ingestion et la consommation d'énergie totale lors d'un repas. Ce mécanisme a cependant été très peu étudié chez les enfants. En outre, le comportement masticatoire a un impact sur la dynamique de formation du bol alimentaire, la libération des composés responsables du goût et la perception sensorielle, qui doivent être pris en compte pour comprendre l'expérience alimentaire d'un repas.

Nous évaluerons le rôle de la texture des aliments et des différences individuelles en termes de vitesse d'ingestion et d'état bucco-dentaire sur (i) le comportement masticatoire, (ii) la transformation de l'aliment en bouche, (iii) la dynamique de libération *in vivo* des composés d'arôme et de perception sensorielle et (iv) la consommation d'énergie *ad libitum* au cours d'un repas.

Le travail proposé impliquera de travailler sur deux sites (France et Pays-Bas) et nécessitera des développements pour adapter les méthodologies disponibles à la population étudiée. L'étude aboutira au développement de nouvelles techniques pour suivre la perception sensorielle temporelle et la libération des composés d'arôme chez les enfants d'âge scolaire, et une étude de concept de l'efficacité d'une intervention basée sur la texture pour modifier la consommation d'aliments lors d'un repas. Ces données nouvelles permettront de mieux comprendre le développement de comportements alimentaires sains en interrogeant le rôle spécifique de la texture des aliments.

### **Préciser le domaine de compétence dans la liste ci-dessous (2 choix possibles maximum – ne pas modifier les intitulés : ils sont imposés par certains sites web) :**

Biologie

### **Mots clés : mastication, texture, children, sensory perception, food oral processing, food intake**

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