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## Achieving optimal folate status for health in European populations

Helene McNulty, Mary Ward, Leane Hoey, Catherine Hughes, JJ Strain and Kristina Pentieva, Northern Ireland Centre for Food & Health (NI-CHE), School of Biomedical Sciences, University of Ulster

Folate has important roles throughout the lifecycle. Notably, conclusive evidence has existed for over 20 years that folic acid supplementation in early pregnancy protects against neural tube defects (NTD). Apart from preventing NTD, emerging evidence supports other roles for folate in maintaining health, from pregnancy, through childhood, to preventing chronic disease in later life. Of particular interest is the link between folate and brain health in ageing and the longer term effect of folate exposure in pregnancy on childhood cognitive development. Biologically, folate is required for one-carbon metabolism and the health effects of folate involve important gene-nutrient interactions and metabolic interrelationships with other B vitamins.

Despite the known and emerging health benefits, achieving optimal folate at a population level can be challenging. This is because the bioavailability of natural food folates is poor compared to folic acid (the synthetic vitamin). Folic-acid fortified foods provide a highly bioavailable vitamin form. Thus biomarker status of folate tends to be lowest in those countries without access to folic acid-fortified foods and highest in countries with mandatory fortification. In countries such as Ireland and the UK with voluntary fortification policies, folate status will vary depending on individual consumer practices. For many Europeans, dietary folate intakes are insufficient in achieving optimal biomarker status.

The variability in folate status is reflected in differences in health outcomes. In European countries, policy to prevent NTD has been largely ineffective. This is because women are generally not compliant with folic acid supplementation as recommended before and in early pregnancy. In contrast, those countries worldwide (n=75) where mandatory folic acid-fortification has been introduced have experienced marked reductions in NTD risk. Of concern, the incidence of NTD in Ireland appears to be increasing in recent years. There are important public health implications (and challenges) of achieving optimal folate status.

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## Session 1.10. Meal design and assessment

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### Introduction

Agneta Yngve, Professor, School of Hospitality, Culinary Arts and Meal Science, Örebro University, Sweden.

Today, dietary assessment is mostly dealing with nutritional quality of the meal and to a lesser extent assesses the environment, the commensality and the design of the meal as such. This seminar is an effort to combine anthropology, meal design and nutrition in a common seminar to increase mutual understanding of a widened approach to meal assessment. Previously, the five aspects meal model has been

proposed as a theoretical framework for commercial meal planning and quality assurance. This model includes the product, the room and the service, combined with the ambience and the management system. In this introductory talk, the five aspects meal model will be compared with methods of marketing, including, product, place, price and promotion and with consumer orientation aspects of social marketing. In the broader aspect of public meal planning, consumer orientation aspects are suggested to be an integral part of meal assessment. Issues related to sustainability, food waste and nutritional status and well-being in a broader sense also need to be taken into consideration in the planning of public meals as well as in the provision of meal guidelines and – support to the public. The other presentations during this symposium deal with meal design in three different contexts, a new way of assessment of individual food choice and a historical overview of commensality and meal design.

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### ICT assisted dietary data acquisition – an overview of novel technologies

Mikkelsen, BE, Dobroczynski, M & Ofei, KA. University of Aalborg, Copenhagen, Denmark

Data collection in dietary intake studies using traditional methods is costly and time consuming and as a result the interest in ICT assisted automated or semi-automated systems is high. Therefore there is considerable interest in methods that can assist this process. Tablet, smartphones in combination with imaging and vision technologies are some of solutions that have shown promising results. This presentation takes the Dietary Intake Monitoring System (DIMS) as a point of departure. It is a device for capturing accurate data on dietary intake. It has been developed for capturing information about patient's meal both before and after consumption in a foodservice setting and is used for assessment of food intake and plate waste. The DIMS is able to estimate the type and amount of food on a plate using an integrated technology based on imaging, weighing scale, IR thermometer and ID technology. The DIMS is used in a sequential mode: first the plated meal is recorded and second the returned plate is recorded. The 2 recordings then return the intake and the plate waste. The results so far indicates a substantial potential for decreasing the workload for registering food intake data. The paper discusses the DIMS technology, present other recent innovations such as the eButton technology developed in the US and other recent ICT assisted approaches to measuring behaviour and suggest directions for future research directions as well as for research infrastructures in this field.

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### The Icelandic example of meal design and food specialities

Bryndís Eva Birgisdóttir, Inga Þórsdóttir, Unit for Nutrition Research, Faculty of Food Science and Nutrition, School of Health Sciences, University of Iceland

Official guidelines for meal design for both children and adults in Iceland are based on the Nordic plate model, divided in thirds of low processed; fish, meat, egg, milk or beans and potatoes, pasta or rice (or

other carbohydrate rich food items) as well as a third for vegetables and fruits. The model is based on sound research into the optimal nutrient composition of the diet and the Nordic food based dietary recommendations for wellness and health, with a dash of Icelandic habitual cultural heritage. These are for example the weight on seafood, cod liver oil, local vegetables and berries, rye bread and milk products, such as skyr. The last made out of milk from the old cattle herds imported at the settlement of Iceland over 1000 years ago. In recent years there has been an increase in local production of different food items, some not grown for a very long time, such as barley, rye and rapeseed. The public itself has gained more interest in growing berries and fruits, such as apples for example, but these are not produced on a consumer scale in Iceland. The Icelandic food production circle does not include all the basic elements found to be of importance in a healthy diet (ex. beans, nuts, oils, cereals, fruits and some vegetables) and therefore, a lot of food would have to be imported and balanced against sustainability concerns. Commensality, eating together as social practice, is common in Iceland, both for breakfast, lunch and dinner among families, friends and colleagues. According to dietary surveys, the public seems to follow the plate model in many ways, both children and adults. But not everyone or everyday and the vegetables and fruits have been fighting for their rightful place on the plate in the habitual diet. However, they are now slowly gaining footage and acceptance as noble protectors of health and great culinary experiences.

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## **“What about lunch? For lunch we only had soup” - An approach to the study of meal design in Portugal**

*Maria Daniel Vaz de Almeida\*, Bela Franchini, Claudia Afonso, Rui Póinhos. Faculty of Nutrition and Food Sciences, Porto University, Portugal*

A meal is an eating occasion in which foods and drinks are consumed following a specific order, at a certain time of the day where place and commensality rules also apply. Our previous research showed that Cape Verdean immigrants adapted in Portugal by modifying the structure and composition of meals, namely breakfast (from a cooked, structured meal to a simpler eating occasion of coffee and bread), but also lunch and dinner with inclusion of soup and wine.

We present a combined approach of qualitative and quantitative methods to illustrate how meals are organized in Portugal. Firstly, semi-structured interviews were carried out as part of the “Food in later life project” to illustrate how Portuguese elderly describe their meals across the life cycle, from childhood to old age (de Moraes et al., 2012). 80 elderly (40 men and 40 women), living in their homes and aged between 65 and 91 years old were interviewed to assess their perceptions of meals during specific periods of their lives, providing a life cycle perspective of foods and meals in a time span of nearly 100 years. Participants’ childhood was marked by economic constraints, which in turn influenced their meal structure and food consumption, specially in the case of those born in the first two decades of the 20th century. Old age, lack of resources, disease and loneliness play important roles in meal structure and food consumption today.

A quantitative study with 24h recalls was used to describe today’s meals in a representative sample of Portuguese adults. 3529 subjects

(52% women) aged between 18 and 93 years were interviewed within the study “Portuguese population food habits and lifestyle” (Póinhos et al., 2009). Food intake, time, meal designation, place and commensality of each meal were registered. On average, respondents had 5 daily eating occasions, lunch and dinner being the most frequent meals eaten, followed by breakfast.

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## **Food and drink combinations in Swedish meals**

*Henrik Scander, PhD student, School of Hospitality, Culinary Arts and Meal Science, Örebro University, Sweden*

The Swedish national survey on dietary intake, Riksmaten, which took place in 2010-11, included details on day of the week, time point of consumption as well as where meals were consumed. The dietary data were collected through an online registration covering four days, combined with questionnaire data on educational level, lifestyle habits and self-perceived health. The data have previously been presented in regards to nutrient intake and food choice related to educational level. An interesting analysis on which drink that is consumed (or reported to be consumed) at different types of meals and with different food combinations and energy intakes has been undertaken.

The results show large differences in choice of drink depending on food choice, gender, day of the week and time of day. We have also shown that a large proportion of the energy intake comes from consumption of sweet or alcoholic drinks in between meals and in combination with meals.

It is important to inform the public about the choice of drink in relation to energy intake, especially for those aiming to restrict their intake. Our results will present a background for such guidelines. Some surprising results in regards to taste combinations will also be briefly discussed, from the sommelier’s horizon.

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## **Historical aspects of commensality during meals in Europe**

*Richard Tellström, School of Hospitality, Culinary Arts & Meal Science, Örebro University, Sweden*

Who are we eating with? There are always companions to relate to in a meal, both to those who are present and they who are on another place or even in a past history. The choice of food and beverages at the market, the selection of flavour and texture combinations, cooking processes and serving the food with different utensils are all originating from a cultural, religious or social context. Commensality therefore seems to not only to be eating together at the same table but also eating with non-present table guests and relations.

During the 20th century in Sweden the eating context and commensality has changed due to urbanization, changing of how families are created, education levels and gender equality. An increased distance between living place and work has made commuting necessary, which effects the commensality at home but also how meals are shared within the work team you belong to. In Sweden’s major cities it is today often more common to live as single but is a single person eating done

alone or do you take part of an immaterial commensality when you live by yourself? The societal changes give an indication that commensality is changing over time and this is probably an expression of values related to the present time and trends (Zeitgeist). The current use of "communal tables" at restaurants might illustrate a need for socializing when eating and also make it easier to go to restaurants when single.

In my presentation I will discuss the question of foods' beverages' and the meals' inner cultural values which can be observed in Sweden the last hundred years and how they interact with the purpose of eating. I will also discuss eating events and raise the question if it is actually the commensality we are consuming, and not the food.

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## Session 1.2. Recommendations on non-nutrient-components

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### The chemoprotective role of the isothiocyanate sulforaphane: From animal models to humans

Albena T. Dinkova-Kostova, *Division of Cancer Research, Medical Research Institute, University of Dundee, Dundee, UK and Departments of Medicine and Pharmacology and Molecular Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, USA*

Cruciferous vegetables are rich sources of glucosinolates and their hydrolytic products, such as the isothiocyanates, which have crucial functions in plant defense. In mammalian cells, the isothiocyanates are potent activators of transcription factor NF-E2 p45-related factor 2 (NRF2), the master regulator of cellular responses which protect against oxidative, electrophilic, and inflammatory stress, the underlying causes for all chronic diseases. Indeed, the isothiocyanate sulforaphane has shown protective effects in numerous animal models of chronic disease, including cancer, neurodegenerative, and cardiovascular diseases. Mechanistically, sulforaphane activates NRF2 by chemically modifying cysteine sensors of its main negative regulator KEAP1, disrupting the cycle of KEAP1-mediated NRF2 degradation. Consequently, NRF2 accumulates and orchestrates the enhanced expression of cytoprotective genes encoding drug metabolizing, antioxidant and anti-inflammatory proteins. In humans, intervention studies, which involve biomarker quantification, suggest that sulforaphane-rich broccoli preparations protect against damage caused by exposures to environmental carcinogens, such as solar ultraviolet radiation, aflatoxin, and air pollutants. With the emerging role of NRF2 in mitochondrial function and intermediary metabolism, it is also becoming apparent that sulforaphane has chemoprotective effects in conditions of compromised mitochondrial function, such as Parkinson's disease in cellular and animal models, and autistic spectrum disorder in humans.

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### Phytochemicals: Non-Essential But Indispensable For Human Health

Bernhard Watzl, *Department of Physiology and Biochemistry of Nutrition, Max Rubner-Institut, Federal Research Institute of Nutrition and Food, Karlsruhe, Germany.*

The consumption of plant foods such as vegetables and fruits is inversely associated with the risk of cardiovascular diseases and some types of cancer. The active compounds in plant foods mediating these preventive effects are still not well characterized. Besides essential nutrients and dietary fibre, which clearly contribute to these effects, plant foods contain a wide range of low-molecular weight molecules with diverse biological activities which are termed phytochemicals. More than 150 years ago, plant physiologists described their synthesis and biological functions within plants. In the past, primarily antinutritive or toxic effects of phytochemicals were investigated in humans. Just for the last 30 years has there been an increasing recognition of the potential health-benefits of phytochemicals in human nutrition.

Phytochemicals mostly occur in minute amounts in plant foods. They are classified according to their chemical structure (carotenoids, phytosterols, glucosinolates, polyphenols, saponins, monoterpenes, and sulfides) and their functional characteristics (antioxidants, anticarcinogens, etc.). The intestinal microbiota contributes to the metabolism of phytochemicals, generating mammalian-specific plant-derived compounds.

Data from epidemiological studies and randomized clinical trials (intervention studies) provide evidence that dietary phytochemicals modulate physiological processes in humans, supporting the concept of health promotion through a high intake of minimally processed plant foods. Further, certain phytochemicals such as lutein and zeaxanthin accumulate in the macula of the human eye, indicating a specific function in this tissue. Experimental data revealed defined mechanisms of isolated and chemically characterized phytochemicals. Recently, EFSA approved health claims for selected phytochemicals, e.g. the flavanols and their effect on vasodilatation, demonstrating their physiologically-relevant bioactivity. Overall, an impressive number of publications suggests a health-promoting effect of these compounds and raised the question, whether specific phytochemicals are essential to human health.

Clearly, phytochemicals do not strictly fulfill the criteria which define essential nutrients. As an example, an inadequate intake of phytochemicals does not generally induce biochemical or clinical symptoms of deficiency. Although not essential to life, phytochemicals may confer a range of effects that may support health. Therefore, already in the 1970s, the German scientist J. Kühnau introduced the term "semi-essential" to emphasize the unique contribution of flavonoids to human health. This term has never been further developed or defined neither for flavonoids nor other classes of phytochemicals. In light of the huge chemical diversity between and within the different classes of phytochemicals, measuring their dietary intakes and investigating their functional effects is an ongoing tremendous challenge to nutritional sciences. We are far from understanding individual exposure, requirements, metabolism, and bioactivity for most of the single phytochemicals.

Kühnau, J. The flavonoids - a class of semi-essential food components: their role in human nutrition. *World Rev Nutr Diet* 24, 117-191, 1976