Personalized Nutrition - A challenging global concept and its implications on innovations in food processing

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INTRODUCTION

“Personalized Nutrition” (PENUT) is on the way to get one of the keywords in food research & development for the next decade. PENUT can be seen as part of a challenging concept to improve the public health status and relieve increasingly difficult to finance national health care systems particularly in the context of global demographic developments. The PENUT concept involves nutritional, material science and process engineering aspects and its major goal may be described as: development of food with nutrition- and health-tailored functions for the optimal individual- to target group-related wellbeing benefit. From a food process engineering perspective PENUT requires processing approaches optimizing the consumer-relevant functional characteristics of the food. Such functions are delivered by functional components (FC), the optimal delivery of their target function has to be supported by the food structure. Consequently PENUT-relevant processing requires function-tailored food process engineering.

MATERIALS & METHODS

For function-tailored food process engineering a reverse engineering approach is recommended. This means (i) starting from the functions to be delivered (ii) food composition and structure are designed and for the generation of such structure (iii) optimized processing operations are then developed, adapted and optimized. Consequently Process-Structure-Property relationships are actually investigated in reverse order as Property-Structure-Process relationships being composed of coupled Property-Structure Functions and Structure-Process Functions.

RESULTS & DISCUSSION

Starting with the “functions” to be delivered to consumers by a food product it gets obvious that beside health supporting target functions of major relevance for the PENUT approach there is a number of other food functions related to quality, safety and convenience with equally crucial importance for the consumer. Recently a holistic description of consumer’s requirements has been suggested [1]. Accordingly consumers’ PAN-profiles reflect their Preference (e.g. sensory properties, convenience aspects), Acceptance (e.g. religious, GMO, animal welfare, ethnic, vegetarian aspects) and Need (e.g. health, nutrition, performance and development aspects). A PAN-optimum function can be expected to be a major descriptor for humans’ wellbeing. Assuming that the acceptance-criteria are fulfilled one can estimate that some of the preference-criteria are determined by the consumer (a) in the state as manufactured in the industrial process, some others are perceived (b) during or after meal preparation or (c) during consumption in mouth and/or nose. Finally the need-criteria are mostly detected by the human digestive system and consumers perceive the results only indirectly (i.e. good feeling and performance or health status) on different time scales (hours to years). From this one can
derive that besides processing in the food manufacture there are further processing impacts by meal preparation, consumption and digestion determining a number of the most relevant food properties for the PENUT approach. As a consequence we suggest an S-PRO² (Property-Structure-PROcess) scheme cascade which best characterizes the PAN-related reverse engineering approach for the PENUT concept as demonstrated in figure 1.

**Figure 1.** S-PRO² cascade demonstrating the multi-level reverse engineering (RENG) approach for the development of PAN-tailored food systems for Personalized Nutrition (PENUT)

For each of the S-PRO² levels (I-IV) the properties are “coded” by related structures $S_{ij}$ (here $i = I-IV$), which is a hierarchically ordered arrangement of structural building blocks at different characteristic length scales $l_{ij}$ (j = e.g.: molecular-, colloidal- and macro disperse scales). Due to the non-equilibrium nature of food structure in general and under transient processing conditions in particular, characteristic time scales $t_{ij}$ can also be assigned to each of the structural length scales. From figure 1 it gets also obvious that the optimized food composition and structure processing in the industrial process (I) should consider structure modification under meal preparation conditions (II) and in particular structure disintegration under consumption (III) and digestion (IV) conditions. III, IV are seen as major determinants for the personalized nutrition (PENUT) concept. It has been demonstrated that in principle the PENUT concept can be applied for individuals or specific target groups in industrialized, emerging and developing countries. First steps of multi-level reverse engineering approaches have been performed for fortified foods functionalized with the micronutrients Fe and Zn. Related specific application concepts were developed concerning personalized nutrition (PENUT) of target groups in industrialized and developing countries. Innovative processing operations adapted within these concepts are (1) dynamic membrane multiple emulsification, (2) double emulsion spray chilling, (3) fortified rice extrusion, (4) micro-media nano milling and (5) vesicle- and emulsion-based capsule processing. Related property-structure-process relationships considering structural multi-scale aspects of some derived PAN-tailored personalized foods will be presented.

**REFERENCES**