Convenience food: investigation of the micronutrient density of industrial finished products compared to their corresponding basic food

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Results of a chemical analysis of Austrian convenience foods and staple foods

Summary

Background / objective of the study

"Fast Food" as an umbrella term for "consuming food fast in-between" is generally associated with pizza-, schnitzel-, and burger chains and is reduced to this. In the everyday reality quick meals now dominate almost all areas of our daily food intake: work, school- and hospital kitchens are increasingly using industrially produced semi-finished products, as well as catering and households. The primary reason for this trend is the saving of costs (time, energy, personnel). The aim of this project was to investigate the influence of industrial processing of staple foods on their biochemical and biological quality. Another goal was to put these findings in relation to the significantly differing Austrian and German food reports of 2012.

Methods

The following basic foods and their corresponding finished products were analysed for their value-determining ingredients: potatoes / instant mashed potatoes, whole milk 3.5% fat / skim milk 0.5 % fat, tomato / instant Cream of tomato soup, apple / apple juice, whole wheat bread / wheat toast. Fat content as well as fatty acid composition, dietary fiber, β-carotene, vitamins of the B group, trace elements and minerals were determined.

Results

Industrially processed foods and ready-made instant meals, in comparison to their corresponding basic food showed losses in vitamins, minerals, trace elements, fiber and essential fatty acids to the extent of 50-90 %.

Conclusion

Dishes from industrially prefabricated ingredients can be sensory hardly differed in everyday nutrition of dishes from native staple foods. The legally permitted ingredients declaration on finished food provides no conclusions to the average consumer in nutrition topics or the loss of biological values of the industrially produced ingredients. Ready meals are hardly different dishes from basic food concerning caloric content, but ready meals show moderate to enormous losses of essential micronutrients and fiber. Against this background, the results of periodically authored, national nutrition reports have to be considered as critical.

Keywords
Convenience foods, food analysis, micronutrients

Introduction

Convenience food is synonymous with "Comfortable Food". This term summarizes pre-processed foods and meals components as well as complete ready meals, eg roasted vegetables / salad, soups from the pack, ready-made sauces, frozen foods, pizza, microwave dishes, etc. Convenience food meets the needs of the consumers insofar as they are taking steps and accelerate the preparation of meals. Convenience products are very popular especially among working professionals, among elderly people, singles and people with little cooking experience or with little time.

In order to serve many guests even under time pressure, catering also makes use of ready-made garments, which can be rapidly processed further. Depending on the degree of processing convenience products are classified into two categories: partly finished foods and foodstuffs ready for consumption [1].

The classical reasoning with the time saving argument for the continuing increase in popularity of convenience products in the private sector also plays a role, but is not by far the only rationale for using these products. As the central factors for the use of convenience products motives as low cooking skills, the low level of knowledge about healthy eating and the setting for "natural" foods have an apparently greater influence than the time factor [2].

About half of the Germans said that they sometimes (37%) or often (16%) buy pre-prepared meals, instead of cooking themselves. Only 8% never use them. In an international comparison, Germany is broadly equivalent to the European average. In Asia, ready-made meals are even more common than in Europe [3].

In each case, 77% of German households use sauces binder, ready sauces in packets and bags as well as ready-made products for meat dishes. Regularly, at least once a week, these products are used by one quarter to one third of all households. Even more frequently consumed are canned vegetables (by 87% of the households) and cooked frozen vegetables (eg cream spinach) (91 %), with 58 % and 63 % of all households consume these products at least once in 14 days [3].

Studies on the nutritional importance of convenience food in the diet of children are still missing.
For this reason, the data of 1985 at the German Research Institute of Child Nutrition in Dortmund (FKE) conducted the DONALD Study (Dortmund Nutritional and Anthropometric Longitudinally Designed Study) were the consumption of convenience food was evaluated in children and adolescents.
The study considered 1158 three-day-weighed-food diaries of 514 subjects (256 boys, 258 girls) aged 3-18 years from 2003-2005. In 853 (74 %) of these protocols at least one convenience food has been logged. Of the 1845 convenience food products were 473 (26%) complete meals and 1381 (74%) meal components.

The 516 logged convenience food products contained a total of 7367 ingredients (average 14.3 ingredients per product), including 1476 (20 %), flavouring or additives. On average, energy density

and fat content were higher than the recommendations for a hot meal in the optimized mixed diet OptimiX® [4].

Primarily the high fat and energy content and the high levels of sodium chloride of convenience products has to be critically evaluated [5].

In 2012, both the Austrian, and the German Nutrition Report were published [6, 7]. Such nutrition reports are performed on behalf of national health authorities in order to investigate and to capture statistically the food habits and nutritional status of the populations. Within the Austrian nutrition report about 1000 people were included, separately interviewed and investigated by gender and age groups. Basis of the German Nutrition Report 2012 was the survey of about 14,000 German citizens. In both studies, the dietary habits were questioned by so-called 24-hour recalls, diet history interviews and recorded weighing protocols [6, 7].

Accompanying to this also anthropometric data such as height, weight, body mass index, BMI, abdominal and hip circumference) as well as data on physical activity were collected for both reports. For the first time blood and urine analyses were also used to detect micro-nutrients as part of the Austrian survey. As expected, the evaluations of these analyses relativized some of the orally collected data. Despite comparable survey methods and culturally similar eating and drinking habits, the two reports showed strongly deviating interview and examination results and drew also different conclusions.

The Austrian Nutrition Report found in the surveyed (and laboratory-tested) groups a large under-supply of omega-3 fatty acids, vitamin D3, beta-carotene, vitamin B6 (especially from the laboratory findings), folic acid and iodine, selenium and zinc [6].

The German Nutrition Survey 2012, however, did not base its data on laboratory values and postulated for the German population only lack supplies of vitamin E, folate and calcium [7].

The aim of this project is to evaluate the nutrient content of some common convenience products that are offered to Austrian households through an Austrian supermarket chain.

For this purpose, products were selected from the shelves whose product name corresponded to its staple food/basic foodstuff.

Background of this selection:

Terms such as cream of tomato soup, mashed potatoes or apple juice suggest consumers with these descriptions, to consume something more "Healthy". Through chemical analysis of each staple food and their corresponding finished products it should be objectified, whether and to what extent the micronutrient contents differed in the measured samples.

As test samples the following basic foods and their corresponding finished products were selected: Potatoes / instant mashed potatoes, Whole milk 3.5% fat / skim milk 0.5% fat, tomato / instant tomato crème soup, apple / apple juice, whole wheat bread / wheat toast.

Methodology

The chemical analyzes were carried out in the laboratories of the Institute Kuhlmann, Center for Analytical Chemistry Ludwigshafen Germany and of vis vitalis gmbh, Unterberg/Germany.

1. Fat was determined following Weilbull/Stoldt (§ 64 Food and Feed Code L06.00-6).
2. The fatty acid composition was determined by gas chromatography on a fused silica capillary after conversion to the methyl esters (area percent report, German Society for Fat Science e.V. C-VI 11d).
3. The nutritional components were determined according to the following analysis procedures:
   - Water after drying (§ 64 Food and Feed Code L 06.00-3)
   - Grease Weilbull/Stoldt (§ 64 Food and Feed Code L 06.00-6)
   - Protein by the Kjeldahl method (§ 64 Food and Feed Code L 06.00-7)
   - Ashes after drying and ashing (§ 64 Food and Feed Code L17.00-3)
   - fiber enzymatic- gravimetric (§ 64 Food and butter means Code L 00.00-18)
4. β -carotene was determined after saponification by LC -DAD (Swiss Food Manual 1536) as the sum of all-trans, 9-cis, 13-cis and 15-cis-β-carotene.
5. The water-soluble vitamins of the B group were determined by VitaFast® microbiological tests. The lyophilized microorganisms proliferate on a micro-titer plate in response to the added vitamin concentration, so that the resulting degree of turbidity is measured photometrically.
6. The minerals and trace elements were determined quantitatively after acid total digestion in a microwave oven by ICP -MS.

Results

The results of individual analyses from the basic food items and their corresponding finished products are presented in Table 1, 3, 4, 6 and 7 as follows.

Potatoes versus instant mashed potatoes

The ingredients lists of the three analysed brand mashed potatoes (Table 1) were cited as follows:

Sample 1: Potatoes (from organic farming), emulsifier from mono-and diglycerides, fatty acids, stabilizer sodium diphosphate, natural flavour, antioxidant ascorbyl palmitate, colouring: spice extract preparation (Rosemary extract from organic agriculture).

Sample 2: Potatoes 99%, emulsifier mono-and diglycerides of fatty acids, antioxidants: sodium meta-bisulphite, flavouring (with Milk).

Sample 3: 78% of potatoes, 18% whole milk powder, salt, stabilizer E450, emulsifier E473, antioxidants (citric acid, sulphur dioxide, L 304), flavour, spice extract.

If we now assume that for the preparation of a consumption-serving of around 200 grams mashed potatoes (without milk, butter or margarine addition) from potatoes around 150 grams of potatoes or 30 grams of instant purees from sample 1, or 27 grams of sample 2, or 36 grams from sample 3, are needed this results in the following intakes of electrolytes, fiber and caloric energy (Table 2).

Analysis parameter	Potatoes, raw	Sample 1 Potato powder	Sample 2 Potato powder	Sample 3 Potato powder
Magnesium	38 mg/100g	16 mg/100g	13 mg/100g	21 mg/100 g
Potassium	624 mg/100 g	265 mg/100 g	262 mg/100 g	245 mg/100 g
Fiber	2,9 g/100 g	6,4 g/100 g	9,8 g/100 g	8,1 g/100 g
Calories	58 kcal/100 g	355 kcal/100 g	345 kcal/100 g	365 kcal/100 g

Table 1: Analysis results Potato / instant mashed potatoes; Sample 1: branded mashed potatoes powder product, organic quality; Sample 2: branded mashed potatoes powder product, conventional; Sample 3: branded mashed potatoes powder product, conventional (with milk)

Analysis Parameter	Mashed potatoes (from raw potatoes	Mashed potatoes (from Sample 1 Potato powder)	Mashed potatoes (from Sample 2 Potato powder)	Mashed potatoes (from Sample 3 Potato powder)
Magnesium	29 mg/100 g	2.4 mg/100 g	1.8 mg/100 g	3.8 mg/100 g
Potassium	468 mg/100 g	40 mg/100 g	35 mg/100 g	44 mg/100 g
Fiber	2.2 g/100 g	0.5 g/100 g	1.3 g/100 g	0.8 g/100 g
Calories	44 kcal/100 g	66 kcal/100 g	55 kcal/100 g	56 kcal/100 g

Table 2: Calculated values for mashed potatoes

Analysis Parameter	Sample 1 Milk 3.6% Fat	Sample 2 Milk 3.5% Fat	Sample 3 Milk 3.5% Fat	Sample 4 Milk 0.5% Fat
unsaturated fatty acids	1 g/100 ml	1 g/100 ml	1 g/100 ml	< 0.2 g/100 ml
Calories	65 kcal/100 ml	64 kcal/100 ml	64 kcal/100 ml	37 kcal/100 ml

Table 3: Analysis results of milk samples

Analysis Parameter	Tomatoes on the vine from Austria	Cherry tomatoes from Italy	Cream tomato soup powder
β-Carotene	0.46 mg/100 g	1.01 mg/100 g	1.5 mg/100 g
Folic acid	9.5 µg/100 g	27 µg/100 g	26 µg/100 g
Calories	17 kcal/100 g	17 kcal/100 g	39 kcal/100 ml soup

Table 4: Analysis of results tomatoes / Instant Cream of tomato soup

Analysis Parameter	Cream tomato soup from tomatoes on the vine from Austria	Cream tomato soup from cherry tomatoes from Italy	Cream tomato soup from cream tomato soup powder
β-Carotene	0.28 mg/100 ml soup	0.61 mg/100 ml soup	0.17 mg/100 ml soup
Folic acid	5.7 µg/100 ml soup	16 µg/100 ml soup	2.9 µg/100 ml soup
Calories	0 kcal/100 ml soup	10 kcal/100 ml soup	39 kcal/100 ml soup

Table 5: Calculated values for cream of tomato soups

Analysis Parameter	Apple*	Apple juice naturally cloudy**	Apple juice clear***
Fiber	2.5 g/100 g	0.13 g/100 ml	0.16 g/100 ml
Calories	58 kcal/100 g	49 kcal/100 ml	43 kcal/100 ml

Table 6: Analysis Results apples / apple juice (*apple Gala, **branded apple juice, 100% apple, naturally cloudy, ***branded apple juice, 100% apple, clear)

Analysis Parameter	Whole meal bread*	Kornspitz** bread	Wheat toast***
Magnesium	100 mg/100 g	73 mg/100 g	25 mg/100 g
Potassium	340 mg/100 g	170 mg/100 g	123 mg/100 g
Manganese	1648 µg/100 g	932 µg/100 g	562 µg/100 g
Iron	2.1 mg/100 g	1,4 mg/100 g	0.86 mg/100 g
Copper	271 µg/100 g	248 µg/100 g	103 µg/100 g
Calories	216 kcal/100 g	270 kcal/100 g	254 kcal/100 g

Table 7: Results of the Analysis of whole grains / white flour products (* 100% whole wheat bread, **brand Kornspitz, organic, ***branded toast)

Whole milk (3.5% fat) versus skimmed milk (0.5 % fat)

- Sample 1: brand fresh mountain farmers hay milk. Whole milk 3.6 % fat pasteurized
- Sample 2: brand whole milk 3.5% fat, pasteurized, homogenized
- Sample 3: Durable brand whole milk 3.5% fat, UHT
- Sample 4: brand skim milk 0.5 % fat UHT,

As expected, skimmed milk contained only less than 20% of the content of essential unsaturated fatty acids in comparison to whole milk. The three analysed whole milk brands (organic quality, pasteurized conventional, ultra heat treated), however, showed no differences in EFS contents (Table 3).

Tomatoes versus instant cream tomato soup

The list of ingredients of the analysed brand cream tomato soup was cited as follows: sugar 21.4%, Tomatoes 17.3%, pasta (durum wheat semolina), starch, iodized table salt, sunflower oil, wheat flour, yeast extract, flavouring, onions, parsley, dye (paprika extract), Maltodextrin, celery, acid; citric acid, basil. Warning: May contain traces of milk, egg, soy and fish. The cherry tomatoes Italian provenance showed about twice as high levels of beta-carotene and about three times higher folate levels as the tomatoes on the vine from Austria (Table 4).

If we now assume that for the preparation of a cream of tomato soup (around 250 ml / serving) about 150 grams of fresh tomatoes are needed, or to produce the corresponding amount from instant powder (28 grams of powder are needed, manufacturer recommendation), this results in the following beta-carotene, folic acid and calorie intake (Table 5).

Apple versus apple juices

Assuming an average weight of about 100-150 grams per apple, this apple covers about 10-15% of our daily recommended fiber requirement of about 25 grams. Apple juices on the other hand, whether clear or cloudy nature, only contain less than one-tenth of the fibrous component of a native apple (Table 6).

Whole meal bread versus wheat toast

The whole wheat pastry kba-Kornspitz contains only more than 70% magnesium than the whole meal bread whereas the wheat-toast contains only a quarter of the amount of whole-grain product. The losses of potassium, manganese, iron and copper were expected also to be significant (Table 7).

Discussion

How much the perceptual limits of consumers disappear between staple foods and processed food, can be seen primarily in the ingredients lists on the labels of various finished and semi-finished food products from: Information in the ingredients lists of finished food - whether for large kitchens or

households - such as "potatoes" in instant mashed potatoes, "tomato powder" in instant tomato cream soup, "full egg", "full milk" and "vegetable oil" in instant pancake do not allow consumers to draw conclusions about the degree of refining and thus on the biological loss of values (proportion of unsaturated or trans fatty acids, fiber fraction, content of vitamins, minerals or trace elements) of the used ingredients.

The chemical analysis of staple foods and their corresponding finished products showed moderate to enormous losses of valuable vitamins, minerals, trace elements, essential fatty acids and plant fibers. Especially food product names that contain the term of staple foods in the product title create a consumer expectation that they consume with this product something "healthy".

That this is not the case could be clearly demonstrated by the carried out analyses. Industrial processing of food obviously has a much greater significance for the loss of physiologically valuable and essential health ingredients in the food than the much-quoted acidic and leached soils. In view of the divergent results of the Austrian and the German diet report [6-7] the following open questions arise from our study results:

1. The proportion of convenience food in daily food plans:
   Although both reports on nutrition used questionnaires that differentiated between staple foods and ready meals, the collected data and calculated still leave on enormous grey areas It is impossible for a person with an average nutritional education in nutrition to differentiate whether, for example, the consumed tomato soup was now made from fresh tomatoes or instant powder, mashed potatoes made from potatoes or potato starch, the breakfast pastries from whole-grain or grey flour.

2. A lack of differentiation in food consumption of basic food and industrial machined products due to missing data from the agricultural statistics: in particular, the German Nutrition Report [7] deals in great detail with agricultural statistical consumption data, but admits at the same time that no valid figures are available about how much of the produced staple food quantities are now industrially processed or reach unprocessed the German kitchen tables.

The question of whether a meal is now made from the respective staple foods or from prefabricated ingredients has practically little effect on the associated calorie intake. But it is crucial with regard to our supply of vital and biologically active micronutrients. The analysed, industrially prefabricated prepared meals mainly comprised only 10-50% of valuable vitamins, minerals, trace elements or fibers compared to the studied native staple foods.

Conclusion

The analysis results showed that already one to two portions of convenience foods in daily meals or drinks to abet an insufficient supply of individual value-determining components such as vitamins, minerals, trace elements, unsaturated fatty acids or dietary fiber.

Literature

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