



Analysis and optimisation of a menu for a vegan day care facility for children

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Abstract

Currently, day care facilities offer vegan meals as well. Scientific nutritional recommendations are needed to ensure an adequate nutrient supply and to implement vegan diets for children according to their requirements. In this context, a checklist for day care facilities was developed based on the Giessen catering vegan food pyramid and the checklist for a vegan lunch menu in company catering. We used the checklist in order to analyse the nutrient contents of the vegan menu in a day care facility, to compare it with the childrens' physiological requirements, to identify possible nutrient deficits and to optimise the menu accordingly. Subsequently, two nutrient analyses were carried out to compare the original menu with the optimised menu. After customizing the recipes, all criteria of the checklist were fulfilled and for almost all nutrients the calculated nutrient contents of the proportionate D-A-CH reference values for nutrient intake related to the lunch were reached or exceeded.

Keywords: communal catering, catering in a day care facility for children, vegan nutrition, vegan diet, quality standards by the German Nutrition Society (DGE), Giessen vegan food pyramid, children's diet

Background and objective

The number of vegetarians and vegans is increasing [1]. In Germany, it is estimated that between 1.1% and 2.0% of adults are vegan [2, 3]. But the exact number of vegetarians and vegans is unknown [4]. The percentage of children, who are fed vegetarian or vegan diets is unclear as well. However, it can be assumed that many vegetarian or vegan parents nourish their children at least meatless or even completely without animal products [5]. This assumption is also emphasised by the fact that in 2018 two day care facilities with an exclusively vegan catering offer opened in Germany.

In addition to other quality standards for communal catering (CC), the German Nutrition Society (DGE) has also published quality standards for catering in day care facilities, which define the basic parameters for catering and thus attempt to optimise the nutrient intake of the target group. However, the quality standards and also the supplementary DGE criteria for an ovo-lacto-vegetarian menu incorporated in the new edition include animal products to cover the reference values for nutrient intake and are therefore not suitable as a guideline for vegan-oriented CC [6, 7].

The checklist for a vegan lunch menu in company catering shows that it is possible to cover the reference values for nutrient intake (with the exception of vitamin B₁₂) on the basis of suitable guidelines, even in a vegan CC [8]. However, there are no scientific studies that explicitly examine the nutrient intake or the nutrient contents of the meals in a vegan day care facility yet.

The present study aims to answer the question whether a vegan lunch menu in a day care facility can cover the proportionate reference values for nutrient intake in childhood, if specific nutritional recommendations, e.g. via a checklist, are applied.

For this purpose, the nutrient content of an existing vegan menu of a day care facility was analysed. On the basis of theoretically derived recipes according to the original menu and a

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Food group	Serving size in g/d (PAL 1.4) ^a	Number of servings according to checklist ^b in 20 MD	Serving size in g/L (PAL 1.4)
cereals, pseudocereals (amaranth, buckwheat) and starchy roots	190	20	50 ^c
legumes ^a or protein-rich foods ^b	40	12	20 ^d

Tab. 1: Exemplary conversion of one serving for adults to one serving for children in lunchtime meals

L = lunch; MD = meal days; PAL = Physical Activity Level

^a Recommendations for age-appropriate consumption quantities (in grams per day [g/d]) with the Optimised Vegan Diet (OVK) [9]

^b Eating plan checklist for vegan lunch (♦ Table 2)

^c Calculation according to quarter approach [6]: $(190 \text{ g} / 4) * 20 / 20 = 47.5 \text{ g} (\approx 50 \text{ g})$

^d Calculation according to quarter approach [6]: $(40 \text{ g} / 4) * 20 / 12 = 16.6 \text{ g} (\approx 20 \text{ g})$

checklist modified for the children's requirements (the above-mentioned checklist for a vegan lunch menu in company catering [8]), a menu optimisation with regard to the food choice was carried out. In a next step, it was checked with a nutrient value calculation with regards to the possible nutrient contents of the dishes. The nutritional value analysis was used to compare the menu before and after the optimisation.

Methodology

The study was conducted at the kindergarten "Erdlinge" in Munich, Germany. The facility, which describes itself as a vegan kindergarten, is supplied by a vegetarian caterer certified by the organic farming association Bioland, specialised in kindergarten lunches using the cook and hold system. For the present analysis, the four-week menu with 20 catering days between the 48th and 51st week of 2018 was used as a basis. At the time of the survey, 13 children were being catered for at the day care facility. All children were aged between two and four years, except for one child being just over four years old.

Development of a checklist with appropriate food choices and serving sizes

The checklist for a vegan lunch menu in company catering [8] contains different food groups and recommended quantities for adults. For the use in a day care facility for children, the serving sizes had to be adapted. For this purpose, the age-appropriate consumption quantities (in grams per day [g/d]) were used according to the Optimised Vegan Diet (OVK) from the publication by Alexy et al. [9]. Since the OVK refers to one day, the serving sizes of the checklist (♦ Table 2) are quartered according to the quarter approach [6], which were adjusted according to the number of servings in 20 catering days (see below). An exemplary conversion for the food groups cereals, pseudocereals and starchy roots as well as nuts and seeds are shown in ♦ Table 1.

In order to consider very young children (1 to 1.5 years), who can also be catered for in a day care facility, an additional column was added with advice on how to apply the checklist for this age group. It often is not yet possible for these children to sufficiently break down solid food in order to optimally absorb the contained nutrients in the intestines. Therefore, it is a good idea to serve certain foods as purees or sauces with filling side dishes such as cereals and starchy roots.

Since with small children there also is an increased risk of choking, the individual eating skills of the children should also be taken into account when using the checklist. For this reason, the checklist explicitly used the nutritionally beneficial group of nuts and seeds only as a ground variant or in the form of mush, and did not include other potentially critical foods such as grapes, sultanas, etc. In general, very young children should never eat food without supervision and not while standing or walking.

Quantitative analysis by means of the checklist

The quantitative analysis of the menu was conducted using the modified checklist (♦ Table 2). The frequency of each food group in the original menu of the day care facility was counted manually and it was accordingly assessed whether the criteria of the checklist were fulfilled or not (♦ Table 3). Subsequently, the menu was optimised on the basis of these results by adding fictitious recipes in order to achieve all criteria of the checklist for vegan lunch catering in the day care facility.

Qualitative nutritional analysis

The basis for the recipes of the original and the optimised meal plan were the dishes' names of the original meal plan. The recipes of the nutrient calculation software OptiDiet Plus version 6.0.0.001 (GOE mbH), which is based on the BLS (version 3.02), were used. Drinks were excluded from the calculation, as no information was available from the day care facility. If certain dishes were already available in a vegan version, these recipes were adopted and modified if necessary. Existing vegetarian or meat dishes were adapted and "veganised" in the software. The calculations are based on the absolute nutrient contents of the foods according to the BLS, which were used for the dishes. Mean values were calculated from all 20 menu days in order to obtain the nutri-



Food groups (with frequencies, quantities ^a and examples)	Implementation for children 1–1,5 years ^b	ful-filled	not ful-filled
Cereals, pseudocereals (amaranth, buckwheat) and starchy roots			
20 servings of at least 50 g (cooked)		X	
of which at least 4 servings whole grain			X
of which max. 4 servings potato products or deep-fried starchy roots (gnoc-chi, dumplings, chips)		X	
Rice: Parboiled rice or brown rice			X
Vegetables and salad (without legumes)			
20 servings of vegetables incl. salad of at least 50 g	possibly pureed as a sauce, patty etc.	X	
of which at least 8 servings raw fruit and vegetables or salad		X	
Fruit (incl. juice)			
16 portions of fruit (without added sugar, fresh or frozen) of 60 g	hard fruit as puree, soft fruit such as strawberries as a whole		X
of which at least 8 portions raw/uncooked		X	
of which max. 4 portions dried		X	
Nuts and seeds (as mush or ground)			
at least 125 g nuts/seeds			
(e.g. walnut baguette made from ground walnuts, walnut puree, ground pumpkin seeds)	without exception as mush or ground		X
Protein-rich foods			
at least 12 servings of at least 20 g	e.g. chickpeas only very soft or pureed	X	
of which at least 4 servings protein products (tofu, tempeh, seitan)		X	
of which at least 4 servings legumes (peas, lentils, beans)		X	
Fats and oils^c			
Rapeseed oil = standard oil (for frying or deep-frying) 20 servings à 5 g			X
Other food planning and production issues			
Use of foods enriched with vitamin B ₁₂ and/or vitamin D (e.g. enriched soy milk) ^c			X
Use of seaweed (e.g. 0.5–1.5 g nori flakes daily)			X
Iodised salt is used, salt sparingly max. 1 g per meal ^c			X
max. 2 servings of fried and/or breaded products per 20 days		X	
Menu cycle is at least 4 weeks		X	
Cereals and starch side dishes are offered in a varied way		X	

Tab. 2: Menu checklist for a vegan lunch menu (modified according to Volkhardt et al. [8] and Alexy et al. [9]) using the example of the vegan day-care centre menu, based on 20 meal days, supplementary preparation instructions for children aged 1–1.5 years and the result of the comparison before optimisation

^a rounded in 5-g-steps

^b Take children's eating skills into account individually, never let them eat without supervision and not while moving, but while sitting. Practical tip: Anything that can be crushed against the palate is unproblematic; anything the size and hardness of a peanut bears the risk of choking.

^c criteria that were not apparent from the menu and were additionally asked for

tional value content of the meals per day and child.

The focus of the analysis was to target the CC lunch recommendations of the proportional D-A-CH dietary reference values for the age group 1 to < 4 years. The Physical Activity Level (PAL) was set at 1.4. The average target energy intake, which was the basis for the proportionate lunch calculations, was 1,150 kcal/day [10]. The reference values for vitamin and mineral intake were based on the respective higher reference value if different values existed for boys and girls.

For lunch recommendations in a day care facility, the calculation is based on the quarter approach, with a share of 25% of the reference value for the daily energy intake [11]. In relation to the current D-A-CH reference values, this corresponds to 320 kcal per child and day [10]. A special focus of the optimisation was on the critical nutrients of a vegan diet, especially vitamin B₁₂, B₂ and D as well as the minerals iron, iodine, calcium and zinc [12].

Results

Quantitative analysis and optimisation via checklist

The evaluation of the menu via modified checklist for a vegan lunch menu in company catering, which was adapted to the children's requirements (according to D-A-CH reference values), showed compliance or non-compliance with the criteria depending on the food group considered (♦ Table 2). Overall, the existing menu met 12 out of 20 criteria (60%) of the vegan checklist, including the number of vegetable servings and the frequency of protein-rich foods. For whole grain products and brown rice the recommendations were not met. The number of servings of fruit did not reach the recommendations, although the recommended minimum number of servings for raw or uncooked fruit was achieved. Nuts and seeds (whole and/or mashed) did not appear in the menu. Rapeseed oil was not the standard oil and neither plant-based milk alternatives enriched with vitamin B₁₂ nor vitamin D and iodised table salt were used.

Taking into account the criteria that were not met, an optimised menu was developed (♦ Table 3). Through the optimisation, all criteria of the checklist for vegan lunch catering could be achieved.



Week	Monday	Tuesday	Wednesday	Thursday	Friday
1 before	Chili non Carne ^a with basmati rice + cream of potato soup and green salad + fresh fruit	Chickpea and vegetable stew with baguette ^b + cream of vegetable soup and raw fruit and vegetables + chocolate pudding ^a	Ravioli ^b with pea filling with tomato sauce + carrot-apple salad + cake	Potato gratin ^b + croûton soup and beetroot salad + fresh fruit	Whole grain pasta ^b with herb sauce ^a + Cream of tomato soup and raw fruit and vegetables + Apple turnover
1 after	Chili non Carne ^a with brown rice + cream of potato soup and green salad + fresh fruit	Chickpea and vegetable stew with whole grain baguette^b + cream of vegetable soup with ground pumpkin seeds and raw fruit and vegetables + chocolate pudding ^a	Ravioli ^b with pea filling with tomato sauce + croûton soup^b with carrot-apple salad + fresh fruit	Potato gratin ^a + red lentil soup and beetroot salad + fruit cake^b	Whole grain pasta ^b with walnut-herb sauce^{a, c} + Cream of tomato soup with ground pumpkin seeds and raw fruit and vegetables + fresh fruit
2 before	Spaghetti ^b with bolognese sauce ^a + croûton soup ^b and green salad + fresh fruit	Mild Thai curry ^{b, d} with basmati rice + cream of sweet potato soup and raw fruit and vegetables + chocolate pudding ^a	Whole grain rice with vegetables and tomato sauce + cream of vegetable soup ^a and cucumber salad + cake ^b	Potato goulash with baguette ^b + root vegetable soup ^a and carrot-apple salad + cake ^b	Whole grain pasta ^b with tomato sauce + sorghum cream soup ^a with raw fruit and vegetables + fresh fruit
2 after	Whole grain spaghetti^b with bolognese sauce ^a + croûton soup ^b and green salad + fresh fruit	Mild Thai curry ^{b, d} with brown rice + cream of sweet potato soup with ground pumpkin seeds and raw fruit and vegetables + chocolate pudding ^a	Whole grain rice with vegetables and tomato sauce + cream of vegetable soup ^a and cucumber salad + vanilla yoghurt with fresh fruit^a	Potato goulash with walnut-whole grain baguette^{b, c} + root vegetable soup ^a and carrot-apple salad + fruit cake^b	Whole grain pasta ^b with tomato sauce + sorghum cream soup ^a with raw fruit and vegetables + fresh fruit
3 before	Stir-fried vegetables with basmati rice + cream of courgette soup ^a and mixed salad + chocolate pudding ^b	Pasta ^b with bolognese sauce ^a + cream of potato soup and raw fruit and vegetables + fresh fruit	Lentil stew with farmhouse bread ^b + croûton soup ^b and carrot-apple salad + banana yoghurt ^a	Rice with vegetables and tomato sauce + red lentil soup and cucumber salad + cake ^b	Mashed potatoes with nuggets ^{a, b} and gravy + cream of sorghum soup and raw fruit and vegetables + fresh fruit
3 after	Whole grain rice with vegetables and tomato sauce + cream of courgette soup ^a with ground pumpkin seeds and mixed salad + chocolate pudding ^a	Whole grain pasta^b with bolognese sauce ^a + cream of potato soup and raw fruit and vegetables + fresh fruit	Lentil stew with whole grain bread^a + croûton soup ^b and carrot-apple salad + apple-banana yoghurt^a	Whole grain rice with vegetables and tomato sauce + red lentil soup and cucumber salad + fruit cake^b	Mashed potatoes with nuggets ^{a, b} and gravy + cream of sorghum soup and raw fruit and vegetables + fresh fruit
4 before	Spring rolls ^{b, d, e} with rice and tomato sauce + cream of vegetable soup ^a and mixed salad + fresh fruit	Pasta ^b with bolognese sauce ^a + cream of sorghum soup ^a with raw fruit and vegetables + fresh fruit	Tortellini ^b with tomato sauce + croûton soup ^b and cucumber salad + chocolate pudding ^a	Chickpea and vegetable stew with baguette ^b + cream of tomato soup and carrot-apple salad + fresh fruit	Baked potatoes with ketchup + soup with fried butter pearls ^b and raw fruit and vegetables + rice pudding ^{with coconut milk}
4 after	Spring rolls ^{b, d, e} with rice and tomato sauce + cream of vegetable soup ^a and mixed salad + fresh fruit	Whole grain pasta^b with bolognese sauce ^a + cream of sorghum soup ^a with raw fruit and vegetables + chocolate pudding^a	Tortellini ^b with tomato sauce + croûton soup ^b and cucumber salad + fresh fruit	Chickpea and vegetable stew with whole grain baguette^b + cream of tomato soup with ground pumpkin seeds and carrot-apple salad + rice pudding ^{with soy milk}	Baked potatoes with ketchup + soup with fried butter pearls ^b and raw fruit and vegetables + fresh fruit

Tab. 3: 20-day menu for the vegan lunch menu at the vegan day care facility Erdlinge e. V., before and after optimisation marked in bold = changes made during optimisation

^a soy; ^b cereals containing gluten (wheat and/or spelt); ^c walnuts (ground); ^d may contain peanuts; ^e sesame



Energy/nutrient	Reference value ^a	Calculated contents	% of reference value (rounded)
per lunch/person			
Energy, macronutrients and fibre			
Energy (kcal)	288	297	103
Protein (g)	16	11.9	74
Fat (g) (30–40% of energy)	11	13.1 (40% of energy)	119
Carbohydrates (g) (min. 50% of energy)	39	29.1 (39% of energy)	75
Dietary fibre (g)	3	7.2	240
Vitamins			
Vitamin D (µg)	5 ^b	0.02	0
Vitamin E (mg)	2	3.39	170
Vitamin B ₁ (mg)	0.2	0.29	145
Vitamin B ₂ (mg)	0.2	0.16	80
Folate equivalents (µg)	30	70.64	235
Vitamin B ₁₂ (µg)	0.4	0.00	0
Vitamin C (mg)	5	31.52	630
Minerals			
Magnesium (mg)	20	78.53	393
Calcium (mg)	150	71.41	48
Iron (mg)	2	2.71	136
Zinc (mg)	0.8	1.2	150
Iodine (µg)	25	15.21	61

Tab. 4: Nutritional analysis of the original 20-day meal plan for lunch before optimisation

^a Reference values for the age group of 1 to under 4 years, PAL = 1.4, corresponding to the quarter approach of the DGE with a share of 25% of the guideline value for the daily energy and nutrient intake of the D-A-CH reference values (rounded)

^b in the absence of self-synthesis

dark green = reference value reached or exceeded

orange = reference value undershot by between 10% and 50%

red = reference value undershot by more than 50%

pink = critical nutrients according to the DGE position paper on vegan nutrition [12]

Qualitative nutritional analysis

♦ Table 4 shows the results of the nutrient analysis *before* optimising the menu. The targeted energy content of the meals was achieved (103%). In terms of macronutrients, protein (74%) and carbohydrate (75%) contents were below the nutrient contents of the meals based on the proportional reference values for nutrient intake, while the fat content of the meals (119%) was above. Very high calculated contents were found for vitamin C (630%) and magnesium (393%). The contents of dietary fibre (240%) and folate (235%) were more than twice the reference values on average. The reference values for iron (136%), vitamin B₁ (145%), vitamin E (170%) and zinc (150%) were also exceeded, whereas the reference values for vitamin B₂ (80%), iodine (61%) and calcium (48%) clearly fell short. As expected, the reference values could not be reached for vitamin B₁₂ (0%) and vitamin D (0%).

A nutritional analysis of the optimised menu was carried out, in each case related to lunch.

♦ Table 5 shows the results of the nutrient analysis *after* the optimisation of the menu.

The targeted energy content was achieved (112%). In terms of macronutrients, protein (90%) and carbohydrate (90%) contents were slightly below the reference values, while the fat content of the meals (109%) was slightly above. With the exception of calcium, vitamin B₁₂ and vitamin D, the target reference values were met or exceeded for all nutrients tested. Very high calculated levels were found for dietary fibre (300%), vitamin C (786%) and magnesium (531%). The contents of vitamin B₁ (205%), folate (249%) and zinc (270%) were more than twice the reference values on average. The reference values for vitamin B₂ (110%) and iron (199%) were also slightly exceeded, while the reference values for iodine (99%) and calcium (77%) fell short more clearly. The reference values for vitamin B₁₂ (0%) and vitamin D (0%) were again not reached.

Discussion

Quantitative analysis by means of the checklist

The quantitative analysis of the original vegan 20-day lunch menu used in the day care facility showed there is great room for improvement at the level of food selection and quantity. This alone suggested that possible deficiencies in critical nutrients such as protein, vitamin B₂, zinc, iron, calcium and iodine were likely due to the low use of whole grain products, nut and seed mush and iodised salt [12]. For protein, vitamin B₂, calcium and iodine, this was also confirmed by the subsequent nutritional analysis of the original menu (♦ Table 4). After optimisation of the 20-day vegan menu plan, all food-related criteria of the checklist could be fulfilled.

Qualitative nutritional analysis

The qualitative nutritional analysis of the original meal plan showed minor deviations in the relative proportion of macronutrients as well as minor deficits in vitamin B₂ and iodine. Major deficiencies were found in the calcium content of the meals. As expected, the target levels for vitamin D and B₁₂ could not be met. For all other nutrients, the nutrient contents of the meals oriented to the proportional D-A-CH reference values for nutrient intake



were met and exceeded by more than double in some cases.

The modification of the menu carried out on this basis as well as on the optimisation of the nutrient contents according to D-A-CH reference values for this age group resulted in many cases in meeting or even exceeding, but sometimes also falling short of the targeted nutrient contents. Thus, the reference values for the protein and carbohydrate contents were slightly undercut and slightly exceeded for the fat content. The guideline value for the energy content was achieved. Overall, a further adjustment of the menu with a slight increase in the protein and carbohydrate content is therefore reasonable. For young children, the recommended daily fat intake is 30–40% [10]. A fat content of the examined meals of 12.0 g on average, which represents approx. 33% of the energy intake, is therefore to be welcomed. Overall, more carbohydrate- and protein-rich components should be used (e.g. more legumes).

With regard to the protein content of the meals, it should be emphasised that the supply of indispensable amino acids must be ensured, as the body cannot synthesise indispensable amino acids from other amino acids or precursors. However, the content of the individual amino acids was not analysed in the present study. A targeted combination of different plant protein sources is therefore recommended to enhance the usually lower quality of plant proteins compared to animal proteins [13, 14]. Such a combination was often given in the analysed diet, e.g. whole grain spaghetti with soy bolognese (grain + soy) or lentil stew with whole grain bread (legumes + grain). Nevertheless, it must be critically emphasised that the protein content of the meals remained below the calculated, proportional D-A-CH reference values for lunch. Especially when considering that the D-A-CH reference values for protein are based on the average protein quality in omnivorous nutrition, it seems reasonable to increase the protein intake in vegan children's nutrition compared to the recommendations. It is therefore most likely that even the optimised menu is still insufficient in terms of protein content [9]. The midday meal plan takes on a special role for the implementation of these reference values. This aspect should therefore be taken up and analysed in further work.

There were also different findings with regard to the micronutrient contents. The reference values

Energy/nutrient	Reference value ^a	Calculated contents	% of reference value (rounded)
per lunch/person			
Energy, macronutrients and fibre			
Energy (kcal)	288	323	112
Protein (g)	16	14.4	90
Fat (g) (30–40% of energy)	11	12.0 (33% of energy)	109
Carbohydrates (g) (min. 50% of energy)	39	34.9 (44% of energy)	90
Dietary fibre (g)	3	9.0	300
Vitamins			
Vitamin D (µg)	5 ^b	0.18	0
Vitamin E (mg)	2	4.17	209
Vitamin B ₁ (mg)	0,2	0.41	205
Vitamin B ₂ (mg)	0,2	0.22	110
Folate equivalents (µg)	30	74.6	249
Vitamin B ₁₂ (µg)	0,4	0.00	0
Vitamin C (mg)	5	39.3	786
Minerals			
Magnesium (mg)	20	106.2	531
Calcium (mg)	150	115.8	77
Iron (mg)	2	3.98	199
Zinc (mg)	0,8	2.16	270
Iodine (µg)	25	24.7	99

Tab. 5: Nutritional analysis of the *optimised 20-day meal plan for lunch*

^a Reference values for the age group of 1 to under 4 years, PAL = 1.4, corresponding to the quarter approach of the DGE with a share of 25% of the guideline value for the daily energy and nutrient intake of the D-A-CH reference values (rounded)

^b in the absence of self-synthesis

- dark green = reference value reached or exceeded
- light green = reference value undershot by less than 10%
- orange = reference value undershot by between 10% and 50%
- red = reference value undershot by more than 50%
- pink = critical nutrients according to the DGE position paper on vegan nutrition [12]

for vitamins B₁₂ and D, which cannot be adequately supplied through native plant foods, could not be reached, not even through the use of enriched foods (soy drink). It is therefore recommended to ensure the vitamin B₁₂ supply in vegan diets in general and the vitamin D supply in the sunless months between October and March by supplementation, regardless of the diet. At least for vitamin B₁₂, the operators of the day care facility studied are also aware of this, because the parents have to certify contractually that they have been informed about the necessity of vitamin B₁₂ supplementation.

For the iron contents of the meals, it is important to point out that the proportional D-A-CH reference values for lunch were exceeded by more than double. However, the bioavailability of iron in an omnivorous diet is 14–18% higher than in a vegetarian and vegan diet.[15] No data is available for the bioavailability from a vegan diet, so that iron deficiency can theoretically occur even with a higher iron intake from plant foods. The authors of the article published in 2020 on the practical implementation of a



vegan children's diet suggest adjusting the iron supplementation recommendations in a vegan diet too [9].

The calculated calcium content of the meals was below the D-A-CH reference value. The most important source of calcium in the diet was the enriched plant drink with 120 mg calcium per 100 mL. For vegans, however, the DGE explicitly recommends in their position paper on vegan diets to use calcium-rich mineral waters (> 150 mg/L) in addition to other foods to cover the reference value for daily calcium intake [12]. With a recommended fluid intake in the age group of 1 to under 4 years of 0.82 L per person and day [10], about 0.2 L should be drunk during a midday meal, taking into account the quarter approach [11]. This would provide at least 30 mg of calcium through a calcium-rich mineral water. Thus, the reference value for calcium intake would also almost have been reached with a total calcium content of 146 mg (97%) for food and beverages. With a mineral water with an even higher calcium content (e.g. ≥ 400 mg/L, as recommended in the Giessen vegan food pyramid) [1], 100 mg of calcium per person a day could thus be supplied via liquids alone during lunch. It would therefore make sense to also integrate the recommendation for calcium-rich mineral waters into the checklist (♦ Table 2).

At 99%, the iodine content of the food only fell short minimally of the intake recommendation for iodine. Current publications point out that the iodine supply of children, as well as that of adults in Germany, is at a low level and is again slightly declining [16, 17]. Therefore, the recommendation of the checklist to use iodised salt as well as seaweed, such as nori, as a source of iodine makes sense. In the case of seaweed, however, it must be noted that it is a natural product whose iodine content can sometimes be subject to large fluctuations [18]. Therefore, it is important to only use products that have a declared iodine content.

In addition to the critical aspects mentioned above, there are also positive findings from the nutritional value calculations and recipe modifications. Particularly the high consumption of fruit and vegetables has to be emphasised positively. These food groups offer the basis of a health-promoting diet due to their high nutrient density, their high content of dietary fibre and secondary plant compounds, and their potential in relation to the prevention of various diet-related diseases [12]. The high amount of dietary fibre resulting from food choices is also positive. High proportions of fibre-rich food groups such as cereal products as well as fruit and vegetables reduce the risk of various chronic diseases (e.g. cardiovascular diseases [19], diabetes mellitus type 2 [20]). However, the consumption of the relevant food groups and thus also the dietary fibre intake of most children in Germany is below the recommendations [21, 22].

A recent German study with vegan, vegetarian and mixed-food children aged 1 to 3 years (corresponding to the age group of the 1- to under 4-year-olds studied here) showed that the dietary fibre intake was highest in vegan children [23]. All children, especially those on non-vegan or vegetarian diets, would therefore benefit from such a food offer. The study also showed that there were no significant differences in energy intake or density between the study groups of different diets. The anthropometric data of the children also showed no significant differences between the diet groups [24].

With a vegan lunch menu, the consumption of fruit and vegetables as well as the fibre intake can therefore be increased and the consumption of animal products, especially meat and sausages, reduced to the recommended maximum amount, even for children who are not on a vegan diet. For vegan children, on the other hand, vegan day care catering offers the opportunity to have a well-prepared, nutrient-optimised lunch. Such vegan day care catering also makes it possible to offer children the same food, regardless of their world views. In other facilities, vegan children have to rely on food they bring with them or often only on the (plant-based) side dishes of a mixed-food menu line.

Finally, it should be pointed out that children are among the population groups with special nutritional requirements for whom a vegan diet is not recommended according to the DGE's position paper on vegan nutrition [12], as the risk of nutrient undersupply or deficiency in a vegan diet is estimated to be higher for children and other persons in sensitive phases of life than for healthy adults. If such risk groups (or their legal guardians) nevertheless decide to follow a vegan diet, the DGE continues, it should be taken care to ensure a sufficient supply of especially the critical nutrients. It is also recommended to seek advice from qualified nutritionists [12].

For the communal catering of children, this means that professionals should also be explicitly trained with regard to vegan offers. This is also indicated by the results of the present survey, which showed a need for improvement in menu planning. So far, there has been no possibility to check the food offered in a vegan day care centre with a checklist comparable to the checklist in the DGE quality standard. This highlights the need for a high-quality vegan checklist that should be evaluated in practice. The checklist developed here is intended to be a first step in this direction, but requires extensive revision, as the following limitations explain.

Limitations

When interpreting the presented results, various limitations must be considered. For example, when evaluating the menu with the help of the checklist for vegan day care catering, only criteria that could either be read out of the menu or obtained through enquiries could be taken into account. It was therefore not



possible to obtain valid information on the use of drinks or exact quantities of vegetable oils.

The optimisation of the recipes was exclusively based on nutritional values. Acceptance and taste were not taken into account. However, this should be done before the checklist is finalised and used. For use in other day care facilities, the recommendations of the checklist would have to be adapted to the individual food intolerances and allergies of individual children.

The optimised menu is based exclusively on the named dishes of the original menu, as the caterer could not provide sufficient information on recipes and/or exact ingredients. The menu analysed here therefore contains fictitious recipes that do not accurately represent the original recipes. The statements that emerge from the nutritional value analysis must therefore be viewed with reservation and can only give indications of the possible nutrient intake in the purely plant-based catering of the day care facility. This therefore presupposes that the children also (completely) consume the meals of the optimised menu presented here. In addition, only lunch was considered as the objective of the study, which naturally only represents a part of the daily diet.

The nutritional analysis also focused on nutrients mentioned in the DGE quality standard, supplemented by various critical nutrients in a vegan diet. The contents of the individual (essential) amino acids, the long-chain omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) as well as selenium in the meals were not surveyed. These should be taken into account in a future review.

Also, the use of the quarter approach may not be optimal. For some nutrients, hot lunch is more important than other meals [6]. Here, the simplified assumption based on the quarter approach can lead to incorrect results. However, the DGE also uses this approach in its quality standard for catering in day care facilities, which is why this problem does not only apply to vegan day care facility catering.

Conclusion

The present work shows that also a vegan day care facility diet has the potential to cover the proportional D-A-CH reference values for energy and nutrient intake of young children for many nutrients. This also applies to most of the critical nutrients of a vegan diet, such as vitamin B₂, iron, zinc and iodine, but not to vitamin B₁₂ and vitamin D. Defined criteria and recommendations must be followed when planning and preparing meals. The checklist presented can be seen as a first approach for defining and implementing these criteria. For vitamin B₁₂ and vitamin D, the supply should be ensured by the parents and outside the facility, as for these the reference values are not reached as expected. If this is ensured, the average need for potentially critical nutrients can also be met at a growing age through plant-based foods, supplemented by the targeted selection of enriched foods and supplements, as also shown in the current publication by Alexy et al. [9].

This is also in line with the position of various national nutrition societies that a well-planned, balanced vegan diet can meet nu-

tritional requirements in every phase of life. This includes pregnancy, breastfeeding and childhood, provided that energy requirements are met and special attention is paid to critical nutrients or supplements [24–28].

A well-developed menu checklist offers the opportunity to develop optimised vegan recipes. These can subsequently contribute to better exploiting the health-promoting potential of plant-based diets in terms of chronic non-communicable diseases [4], while minimising the risk of possible nutrient deficiencies. Such a checklist for planning a vegan-oriented lunch offer can, like the checklist for a vegan lunch menu in company catering, serve as a working basis for recipe planners, buyers and cooks as well as other professionals working in catering management [8]. Especially when catering for risk groups, concrete food-related checklists can help to meet the nutritional and physiological requirements of vegan people. The checklist developed here should be regarded as a first suggestion that should be further optimised in regard to various aspects. Finally, the use of such checklists should be further investigated and evaluated in practice, e.g. in order to integrate guidelines in the quality standards for catering in day care facilities that ensure a purely plant-based diet adapted to nutritional requirements.

Conflict of Interest

Dr. Markus Keller is an unsalaried member of the scientific advisory body of the German Vegetarian Union e. V. and the *Albert Schweitzer Stiftung für unsere Mitwelt*.

Tim Ritzheim operates a website focusing plant-based nutrition.

The other authors declare no conflict of interest.

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