

# Checklist for a vegan lunch menu in public catering

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## Summary

Currently the *DGE-Qualitätsstandards für die Betriebsverpflegung* (quality standards for company catering by the German Nutrition Society [DGE]) provide only recommendations for a nutritionally balanced lunch menu for a mixed diet including animal products. There are not (yet) any stipulations for a vegan menu comprising plant-based food items only. In this context, derivations were performed based on the *Gießener vegetarische Lebensmittelpyramide* (Gießen vegetarian food pyramid) for a 5-day vegan lunch offer in public catering, using the *Drittelsatz* of the DGE (the ‘one-third principle’, which states that a third of nutrient amounts should be provided by lunch) modelled on the checklist by the DGE quality standard. Further, an analysis of the nutritional value of an existing vegan meal plan from the university canteen *Mensa am Park* in Leipzig, operated by the *Studentenwerk Leipzig* (student services organization), was performed before and after the menu was optimized. The aim was to verify the derived recommendations. As an outcome, this paper presents a checklist for a vegan lunch menu for one week (5 days), including amounts and examples of food groups. This checklist can be used as a working basis for persons planning recipes and meal plans, buying food supplies and cooking vegan meals, and for everyone working in catering and kitchen management in order to fulfil the nutritional needs of vegan customers and consumers.

**Keywords:** public catering, company catering, vegan diet, DGE quality standard, Gießen vegetarian food pyramid

but other aspects (e.g. a different representative nature of the figures due to different survey methods and numbers of participants, and perhaps a slightly different definition of ‘vegan’ etc.) could also explain the higher percentage in the more recent study. Both ecological [3] and health-related reasons, such as a frequently proven reduced risk of non-communicable diseases, e.g. hypertension and cardiovascular disorders [4–9], support an increase of more plant-based dishes. These could even be arguments for non-vegetarians and non-vegans to choose a vegan meal for lunch more often.

While ovo-lacto vegetarian meals are now mostly common in public catering and gastronomy, the complete elimination of animal products like cheese, butter, cream and eggs poses a huge challenge for cooks lacking appropriate experience. Furthermore, as with every diet vegans have to ensure that their meals are nutritionally balanced. Public catering, e.g. company and university canteens, can and should contribute by offering tasty, healthy vegan dishes. These meals should also consider essential nutrients to ensure that guests can purchase a healthy vegan lunch on work days. The aim of this work was to develop practical, food-based recommendations for company and university catering in the form of a checklist, modelled on the checklist by the DGE quality standard [10].

## Introduction and objective

According to the *Nationale Verzehrsstudie II* (National Nutrition Survey II), in 2005/2006 vegans made up 0.1% of the population in Germany [1], whereas the *Vegetarierbund Deutschland e. V.* (VEBU; German Vegetarian Union) estimated that there are approximately 900,000 vegans, corresponding to 1.1% of inhabitants, based on a 2014 study by YouGov [2]. Considering the time period between these two studies, this could suggest an increase,

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food group	amount <sup>1</sup>	comments <sup>1</sup>	amount for one lunch <sup>2</sup>	amount for one week in public catering (= 5 lunches)
water and other non-alcoholic drinks low in energy	1–2 L/day		~ 0.35–0.65 L	~ 1.75–3.25 L
cereal products and potatoes	2–3 portions/day	portion: 80g cereal raw = 250g cooked 125g pasta raw = 300g cooked 100–150g bread 200–350g potatoes; wholegrain as standard	~ 1 portion	~ 5 portions
vegetables (without pulses)	min. 400 g/day	including raw vegetables and salad max. 1/4 as juice	~ 135 g	~ 675 g
fruits	min. 300 g/day	max. 50 g dried fruits max. 1/4 as juice	~ 100 g	~ 500 g
nuts and seeds	30–60 g/day	also nutspreads/nutbutter	10–20 g	50–100 g
milk and dairy products	0–250 g milk or yoghurt or 0–50 g cheese/day	unsuitable for vegans	n/a	n/a
eggs	0–2 pieces/week	unsuitable for vegans	n/a	n/a
pulses	1–2 pieces/week	portion: 40 g raw or 100 g cooked	-	~ 1 portion/week
soy products and other foods rich in protein	50–150 g/day	e.g. seitan, tempeh	~ 15–50 g	~ 85–250 g
plant-based oils and fats	2–4 tablespoons/day		~ 0.67–1.33 tablespoons	~ 3.5–6.5 tablespoons (= 35–65 g) <sup>3</sup>
<b>non-quantitative recommendations</b>				
snacks, alcohol, sweets	moderate consumption	if wanted		qualitative recommendation
foods enriched with vitamin D and supplements	sufficient consumption	qualitative recommendation		qualitative recommendation
physical activity for at least 30 minutes per day				
<b>additionally for vegans</b>				
products rich in vitamin B <sub>12</sub>	enriched foods (soy drink, juice)	sufficient consumption		qualitative recommendation
	supplements	sufficient consumption		qualitative recommendation
products rich in calcium	dark green vegetables, nuts, seeds	sufficient consumption		qualitative recommendation
	mineral water rich in calcium	sufficient consumption		qualitative recommendation
	enriched foods (soy drink, juice)	sufficient consumption		qualitative recommendation
and vitamin B <sub>12</sub> supplements and at least 15 minutes exposure to sunlight per day (for endogenous synthesis of vitamin D)				

Tab. 1: Recommendations from the Gießen vegetarian food pyramid by LEITZMANN and KELLER [11] and implications for public catering

<sup>1</sup> according to recommendations from the Gießen vegetarian food pyramid by LEITZMANN and KELLER [11]

<sup>2</sup> according to the one-third principle of the DGE [12]

<sup>3</sup> according to the „Monica-Mengenliste“ (list specifying portion sizes) [13]

max. = maximally; min. = minimally; n/a = not applicable

## Methods

The Gießen vegetarian food pyramid by LEITZMANN and KELLER [11] offers guidelines on the level of food groups and portion sizes which can be applied to an individual diet. The recommendations cover ovo-lacto vegetarian eating patterns, which contain eggs and dairy products, but also purely vegan diets, where no animal products are consumed at all. Some of the re-

commendations apply to a period of one week (= 7 days), while others apply to daily intakes. The DGE applies its so-called *Drittelansatz*, a principle saying that lunch should account for one third (30–35%) of a person's daily food intake [12]. Using this principle, it is possible to mathematically derive recommendations for amounts and portion sizes for food components

for 5 vegan lunches (= one week in public catering). After this derivation, the vegan recommendations for public catering were compared with the recommendations for a mixed diet in public catering by the DGE [10]. This enabled further adjustment and for the information to be specified. The recommendations were transformed into a checklist.

As an example, a nutritional analysis was performed on a vegan meal plan for 20 days, using information from a university canteen, the *Mensa am Park in Leipzig*; this was followed by another nutritional analysis of an optimized meal plan based on the vegan checklist. A PAL (= physical activity level) of 1.6 was used, since students – i.e. young, healthy adults in general – were the target group.

## Results

### Derivations from the Gießen vegetarian food pyramid

The following derivations were established based on the one-third principle of the DGE [12] and the Gießen vegetarian food pyramid [11]. These form recommendations for a vegan

lunch, and therefore for a vegan menu spanning five days (usually Monday to Friday) (♦ Table 1).

The (qualitative) recommendation to consume lots of dark green vegetables, which are rich in calcium, was transferred into a quantitative specification of “one portion of dark green vegetables per week”. For fruit an amount of 500 g per week was recommended. Because one whole piece of fruit weighs approximately between 50 and 200 g [14], it was deduced that approximately 4 portions of fruit per week would meet the requirements. This rather loose specification, which does not specify a certain number of grams, is especially suitable given the needs of kitchen staff for flexibility. For example, it allows the preparation of mixed salads of fruit and vegetables, fruit desserts (fruit drinks, fruit

pudding) or dried fruits, all of which can be counted in this category in this way.

The derived requirement of 30–60 g, so an average of 45 g, of nuts and seeds per day was used to formulate the recommendation of at least 15 g per lunch on average (and 75 g in total for 5 lunches).

The amount of protein products varies between 85 and 250 g (mean value: 167.5 g), because this category includes food items with both a low energy density (e.g. soy drinks) as well as those whose energy density is higher (e.g. tofu, seitan). Furthermore, recommending approximately one portion of pulses, which are also rich in protein, seems to be practicable across 5 days of lunches. In analogy to the maximum of 2 portions of meat and at least 1 portion of fish per week

food group	lunches for 1 week vegan menu <sup>1</sup>	lunches for 1 week mixed diet DGE checklist <sup>2</sup>	comments from the checklist <sup>2</sup>	recommendations for amounts for foods by DGE in 1 week <sup>3</sup>
water and other non-alcoholic drinks low in energy	~ 1.75–3.25 L	5 portions	drinking water oder mineral water	n. s.
cereal products and potatoes	~ 5 portions	5 portions	min. 1 portion whole grain, rice only parboiled or brown rice, max. 1 potato product	200–250 g/day cereal (product) or potatoes and 1 bun (45 g) per week
vegetables (without pulses)	~ 675 g	5 portions	from that min. 2 portion raw/salad; pulses count in this category	200g/day
fruits	~ 500 g	min. 2 portions	fresh or frozen, without added sugars	400 g/week
nuts and seeds	50–100 g	n. s.	none	30 g/week
milk and dairy products	unsuitable for vegans	min. 2 portions	milk 1,5% fat, joghurt 1,5–1,8% fat, cheese max. full fat, curd max. 20% fat	300 g/week milk and dairy and 60 g cheese/ week
eggs	unsuitable for vegans	n. s.	n. s.	1 egg/week
pulses	~ 1 portion/week	n. s.	belongs to vegetables	n. s.
soy products and other foods rich in protein	~ 85–250 g	n. s.	instead: fish, egg, meats and sausages	compare: eggs, meats and sausages, fish
plantbased oils and fats	~ 3,5–6,5 table spoons (= 35–65 g) <sup>4</sup>	n. s.	rapeseed oil as standard	8 g/week rapeseed oil and 10 g/week butter
meats and sausages	n. s.	max. 2 portions	min. 1 portion lean meat	250 g/week meats and sausages
fish	n. s.	min. 1 portion	min. 50% fatty sea fish	150 g/week sea fish

Tab. 2: Comparison of the vegan lunch and the mixed diet of the DGE, where PAL = 1.6

<sup>1</sup> derivations compare ♦ Table 1

<sup>2</sup> recommendations according to the DGE checklist for company canteens [10], p. 36

<sup>3</sup> recommendations for amounts of foods, according to the DGE quality standard for company canteens, PAL = 1,6 [10], p. 41

<sup>4</sup> according to „Monica-Mengenliste“ [13]

DGE = German Nutrition Society; max. = maximally; min. = minimally; n. s. = not specified

recommended by the DGE quality standard for an ordinary diet [10], a recommendation was derived for a total of 3 portions of protein-rich foods for one week. Although specifying 2 portions of protein products and 1 portion of pulses would actually have been slightly closer to the actual derivation from the Gießen vegetarian food pyramid, it was yet decided to allow a more flexible choice. This is due to the assumption that both food categories can help meet a person's protein requirements. Accordingly, a portion size of at least 80g was set, with at least 3 portions per week. Of these 3 portions, at least 1 should be made from pulses (beans, lentils, peas) and at least 1 should be a protein product (tofu, tempeh, seitan). Furthermore, it was calculated that 35–65 g of oils and fats would need to be added per week.

### Comparison with the DGE quality standard for company (and university) canteens and adjustment

Next, the derivations from the Gießen vegetarian food pyramid were compared with the recommendations for a mixed diet from the DGE quality standard (♦ Table 2). This made it possible to perform a few adjustments and alterations.

While the Gießen vegetarian food pyramid provides highly varying information on portion sizes for various cereals and starchy foods [11], for a PAL of 1.6 the DGE recommends approximately 200–250 g of cereals, cereal products and potatoes as a portion size. As a vegan checklist needs to define the portion size for this category, a minimum size of 200 g (cooked) is plausible. The DGE category “cereals, cereal products and potatoes” [10] was replaced by “cereals, pseudo-cereals and starchy tubers”. In analogy to the DGE checklist, the vegan checklist adapts the maximum of one portion of potato products (including

Checklist for a vegan menu (5 lunches = 1 week) in public catering including examples for food items and recommended portion sizes	fulfilled	not fulfilled
<b>cereals, <i>pseudocereals (amaranth, buckwheat) and starchy tubers</i></b>		
5 portions per week <i>à min. 200 g (cooked)</i>		
from that min. 1 portion of whole grain		
from that max. 1 portion of products of potatoes or <i>starchy tubers (fries, gnocchi, dumplings)</i>		
rice: parboiled rice or brown rice		
<b>vegetables and salads (<i>without pulses</i>)</b>		
5 portions of vegetables and salads <i>à min. 135 g</i>		
from that min. 2 portions as salad or raw vegetables		
<i>from that min. 1 portion of dark green vegetables (kale, spinach, leek, celery)</i>		
<i>from that max. 1 portion as juice (e.g. tomatoe juice)</i>		
<b>fruits</b>		
<i>4 portions of fruits</i>		
without added sugars, fresh or frozen		
<i>from that min. 2 portions of raw fruits (fruitsalad, drink, whole fruit)</i>		
<i>from that max. 1 portion of dried fruits (raisins, dried apricots, cranberries)</i>		
<i>from that max. 1 portion as juice/drink (e.g. orange juice)</i>		
<b>nuts and seeds</b>		
<i>min. 75 g nuts/seeds (walnuts, pumpkin seeds)</i>		
<b>protein-rich foods</b>		
<i>min. 3 portions per week à min. 80 g</i>		
<i>from that min. 1 portion of high-protein products (tofu, tempeh, seitan)</i>		
<i>from that min. 1 portion of pulses (peas, lentils, beans)</i>		
<b>fats and oils</b>		
rapeseed as standard oil ( <i>for frying, deepfrying</i> )		
<i>3–6 tablespoons (35–65 g)</i>		
<b>other recommendations concerning the preparation</b>		
<i>using of foods enriched with vitamin B<sub>12</sub> (soydrink, juice)</i>		
<i>using of foods enriched with vitamin D (soydrink, juice)</i>		
<i>providing mineral water rich in calcium (min. 150 mg/L)</i>		
iodized salt as standard, moderately used, <i>max. 2 g per meal</i>		
max. 2 portions of fried or breaded products <i>per 20 days</i>		
menu cycle lasts at least 4 weeks		
cereals, <i>pseudo-cereals and starchy tubers (potatoes, sweet potatoes)</i> in variation		
regard towards preparation with low fat		
the preparation of vegetables and <i>starchy tubers</i> is protective of nutrients		
short periods of heating and keeping warm (max. 3 hours)		
moderate use of sugar		

Tab. 3: Checklist for a vegan menu for one week (= 5 lunches) in company catering  
*blue + italic* = modifications compared to the DGE checklist  
 max. = maximally; min. = minimally

products made from starchy tubers grain quality in rice was adopted. in general) per week. The DGE re- While the DGE only demands at least quirement of parboiled or whole- one portion of whole-grain products

number of days: 20				
	reference levels for 20 days	actual amount	fulfillment in %	fulfillment in % (in relation to energy content)
energy (kcal)	16,000	13,484	84	
protein (g) (20% of the energy)	780	466	60	71
fat (g) (30% of the energy)	540	614	114	135
carbohydrates (g) (50% of the energy)	1,960	1,473	75	89
fiber (g)	200	277	138	164
vitamin E (mg)	100	166	166	197
vitamin B <sub>1</sub> (mg)	10	9	88	104
folate (µg)	2,000	2,953	148	175
vitamin C (mg)	740	1,332	180	214
calcium (mg)	6,660	4,062	61	72
magnesium (mg)	2,340	3,008	129	153
iron (mg)	100	121	121	143
zinc (mg)	67	61	92	109

Tab. 4: Analysis of a 20-day meal plan, before optimization

per week [10], the Gießen vegetarian pyramid recommends these as standard, several times daily and in alteration with potatoes (no mention is made of other starchy plants such as pseudo-cereals like quinoa, or starchy tubers like cassava) [11]. This would actually restrict the flexibility of cooks, because for example some industrial/convenience products like German *Spätzle* or rice noodles are not easily accessible in whole-grain quality. The vegan

checklist therefore includes the need for one portion of whole grain per week. Furthermore, the category of vegetables was specified in the vegan checklist; based on the DGE quality standard, it now includes two portions of raw vegetables and salads a week [10]. Since the DGE categories “meats, fish, sausages and eggs” and “milk and dairy products” are irrelevant, the vegan checklist is supplemented by the two new categories “protein-rich foods” and “nuts and

seeds”. With regard to nuts and seeds, the DGE does actually recommend at least 30 g each week, although this does not explicitly form part of the DGE checklist [10].

The DGE defines rapeseed oil as standard oil [10]. This applies universally to cooking processes involving a lot of heat (e.g. deep frying). For other processes and for the preparation of cold salads, the use of other oils (e.g. olive oil, sesame oil, peanut oil, linseed oil) is permitted, although rapeseed oil is still the standard.

Further, according to the DGE iodized salt should be used, albeit in moderation [10]. In Germany, salt is usually consumed as salt hidden in convenience products like bakery goods, meats, sausages, dairy products and cheese [15]. Vegans thus have a lower risk of high salt consumption than people who eat meat and dairy, provided that vegans refrain from consuming salty convenience products. Based on the one-third principle, the adapted vegan checklist therefore includes a maximum of 2 g of added iodized salt per lunch meal.

Qualitative demands for preparation from the DGE checklist which are associated with maintaining nutritional value (careful preparation, low in fat, short periods of keeping the food warm, sparing addition

	Monday	Tuesday	Wednesday	Thursday	Friday
week 1	vegan 'döner' + <b>fruit-salad with rice pudding containing soy drink</b>	fried sweet potatoe with turnips, walnuts and <b>mangold + raisins</b>	<i>brasilian vegan chili in bellpepper pod, <b>jasmine rice (whole grain) + 1 peach</b></i>	smoked tofu in sauce of Dijon mustard, mash of potatoes and beetroots + <b>salad of fennel and oranges</b>	gratin of vegetables and mushrooms with a crust of tahin and potatoes + <b>1 piece of melon</b>
week 2	<i>asparragus asian style, glass noodles + <b>soy drink with banana</b></i>	hummus oriental style, <b>whole grain bun (wheat), salad of apples and carrots</b>	<i>couscous with mango and lentils + <b>lettuce</b></i>	baked artichocks with tomatoes + <i>fried and breaded tofu + <b>red fruit jelly</b></i>	<i>zucchini gratinated with nuts, rice noodles, sugo of tomatoes and cilantro</i>
week 3	chili con tofu, turkish fleat bread + kiwi	<i>lentils with spinach, couscous + <b>tomatoe salad with linseed</b></i>	<i>potatoe gratin with German sauerkraut containing apples and <b>hazelnuts</b></i>	<i>seitan 'Sauerbraten' style, red cabbage with apples, potatoe dumplings</i>	oriental pilaf made of millet + <b>1 carrot salad</b>
week 4	<i>avocado with sauce made frim chili and fruits, glass noodles + <b>cucumber salad with sesame</b></i>	<i>fried chanterelles with green asparragus, fried baby potatoes + <b>1 coconut drink with raspberries</b></i>	daal indian style, <b>turkish fleat bread (whole grain) + radish salad with sunflower seeds</b>	ragout of chickpeas and vegetables in coconut milk with <b>peanuts</b> , polenta with pumpkin seeds + <b>nectarine</b>	curry with Brussels sprouts and tofu

Tab. 5: 20 day meal plan, optimized  
 bold = newly added component; italic = altered/extended recipe

of sugar) or for meal planning (4-week menu cycle, variety of starchy products) [10] were also adopted. A maximum of 2 portions of deep-fried or breaded food items are permitted in 20 days. The vegan checklist is completed by adopting the qualitative recommendations of the Gießen vegetarian food pyramid to use products enriched with vitamin B<sub>12</sub> and vitamin D and to offer mineral water enriched with calcium (> 150 mg/L).

This resulted in the checklist for a vegan meal plan as shown in ♦ Table 3; the modifications compared to the DGE checklist are highlighted in blue and italic.

### Nutritional analysis before and after optimization

As an example, a nutritional analysis of a 20-day meal plan from a university canteen, the *Mensa am Park* in Leipzig, was performed. The assessment was based on the reference levels from Germany, Austria and Switzerland (*D-A-CH-Referenzwerte*) as used in the quality standard [10]. In addition to the 12 relevant nutrients stated here, zinc was included because intake levels of zinc are sometimes stated to be critical for a vegan diet [4]. ♦ Table 4 shows the analysis of each of the 4 weeks in absolute figures and relative to the energy content. This was done to illustrate the actual nutritional balance of the meal plan and to refrain from bias.

As shown in ♦ Table 4, in terms of energy content as well as in absolute figures there is a higher fat proportion than recommended for lunch, and in turn a lower proportion of protein and carbohydrates. There is also a deficit as regards calcium and an absolute deficit (but not relative to energy content) in vitamin B<sub>1</sub> and zinc. The other requirements are fulfilled and in some cases even double the required minimum. Furthermore, the energy density of the lunches fluctuates considerably between 276 kcal and 1,324 kcal. The

number of days: 20				
	reference levels for 20 days	actual amount	fulfillment in %	fulfillment in % (in relation to energy content)
energy (kcal)	16,000	15,038	94	
protein (g) (20% of the energy)	780	580	74	79
fat (g) (30% of the energy)	540	579	107	114
carbohydrates (g) (50% of the energy)	1,960	1,808	92	98
fiber (g)	200	356	178	189
vitamin E (mg)	100	209	209	222
vitamin B <sub>1</sub> (mg)	10	13	130	138
folate (µg)	2,000	3,719	186	198
vitamin C (mg)	740	1,689	228	243
calcium (mg)	6,660	5,183	78	83
magnesium (mg)	2,340	4,159	178	189
iron (mg)	100	156	156	166
zinc (mg)	67	83	124	132

Tab. 6: Analysis of a 20-day meal plan, after optimization

checklist was used to optimize the meal plan. To this end, the chronological order of the lunches in this 20-day period was changed. Additionally, priority was given to existing recipes from the *Studentenwerk Leipzig* (student union), which were sometimes altered or extended. ♦ Table 5 shows the optimized menu. The post-optimization nutritional analysis now yields different results, as demonstrated in ♦ Table 6. The distribution of the macronutrients is now more in

line with the recommendations, while the energy, carbohydrate and protein levels are lower than recommended at 94%, 92% (in relation to energy: 98%) and 74% (in relation to energy: 79%) respectively, and at 107% the fat content is higher than recommended. ♦ Figure 1 illustrates the relative content of macronutrients and micronutrients during the individual weeks. Furthermore, the requirements for all micronutrients but calcium (78% in absolute figures, 83% considering the

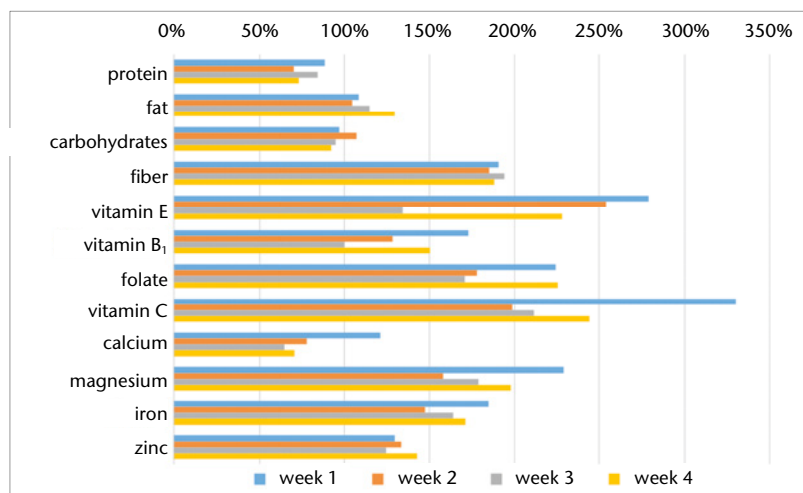


Fig. 1: Nutritional values from each of the four weeks relative to energy content, after optimization

energy content) are fulfilled. Adding one glass (400 mL) of calcium-rich mineral water at 150 mg calcium per liter, which should be provided anyway according to the vegan checklist, would increase the calcium intake by around 60 mg. This is approximately 18% of one third of the daily calcium requirement – and would thus help to achieve the nutritional goal that is set for one lunch portion.

## Discussion

It was possible to derive many recommendations for a lunch menu from the Gießen vegetarian food pyramid [11], and alter or complement these by using the recommendations of the DGE quality standard [10] or based on other plausible reasons presented in this paper. Some statements were simplified for pragmatic reasons, while others were transferred from qualitative to quantitative recommendations, e.g. “min. one portion of dark green vegetables per week” or “max. one portion of dried fruit per week”. Furthermore, the vegan checklist refrained from explaining certain food groups, instead naming examples (e.g. for the category “protein-rich foods”). Thus there were no restrictions as to which vegetables would or would not count as “green vegetables”, even if the amount of calcium in these vegetables varies. Categories like “nuts and seeds” are not explained further, so that food items that would not belong in this food group from a botanical point of view (such as peanuts, which are actually pulses, but from a nutritional point of view are similar to real nuts and seeds) may be counted in this category. This decision was necessary since the easy implementation of the vegan checklist was a high priority. The nutritional analysis of the optimized plan shows the fulfilment of all micronutrient and mineral needs that were examined (if calcium-rich water is consumed additionally), while the proportions of macronutrients vary and the energy content is generally lower

than one third of the daily requirement. It should be remembered here that the basis of the analysis was the one-third principle of the DGE, which is used in the quality standard for canteen (and university) catering. In other settings, when more snacks between meals can be assumed (e.g. in kindergartens) or smaller, yet more daily portions are preferred (e.g. in nursing homes), the DGE uses a one-quarter approach for lunch portions [12]. For a vegan menu, there are reasons which support both approaches, so a lower energy content in a vegan lunch cannot always be classified as negative.

The protein intake is lower than the reference level, but amounts to 580 g in 20 days, meaning a daily lunch average of 20 g. The DGE recommends 0.8 [12] and the World Health Organization (WHO) a minimum of 0.83 g [16] of protein per day per kilogram of body weight. This corresponds to a protein portion of e.g. 9–11% of the energy content for a PAL of 1.4 [12]. The higher daily reference value in the quality standards is explained by the fact that it is easier to accept and implement [12]. The even higher recommendation for protein at lunch is derived from cultural eating patterns and the assumption that lunch contains foods of animal origin such as fish, meats and eggs more often than other meals [12]. So the DGE sets the recommendation for protein at 20% of the energy intake, and at 15% for a full day [12]. This eating pattern does not necessarily need to be the same for German vegans, who consume on average 11–13% of their daily energy through protein [17]. Using the one-third principle of the DGE, a healthy lunch would contain 21.3–22.1 g protein to fulfill the requirement of an average person weighing 80 kg, so even less than what is offered by the optimized vegan menu.

The higher fat content (107% in absolute, 114% in relative figures) is not necessarily problematic. According to the DGE's evidence-based guidelines for fat intake, a higher percentage of total fat in nutrition ad libitum proba-

bly leads to an increased risk of obesity [18]. However, this should not be of concern to vegans and ovo-lacto vegetarians, since they tend to have a body mass index (BMI) which is lower than the ideal BMI and display lower obesity levels [6, 8, 17]. In general, fat intake accounts for 30% in vegan populations, which is perfectly in accordance with general recommendations [5]. Nevertheless, the DGE states that isocaloric, energy-controlled nutrition is of course possible and by definition not associated with the risk of obesity [18]. The quality of fat consumed is of rather high importance. For example, there is evidence to suggest that replacing saturated fatty acids for polyunsaturated fatty acids probably reduces the risk of coronary heart disease [18].

The amount of carbohydrates is lower than the reference levels. The DGE recommends that carbohydrates account for 50% of the daily energy intake. One reason for this are the beneficial effects of whole-grain products and evidence which indicates that these reduce the concentration of cholesterol, and LDL-cholesterol in particular [19]. Evidence shows that the risk of diabetes mellitus, hypertension and coronary heart disease probably decreases as a result of consuming whole grain [19]. In total, no correlation is identifiable between overall carbohydrate consumption and a higher risk of the examined chronic diseases, or this is not verifiable using any evidence [19]. However, fiber intake, which evidence suggests probably reduces the risk of obesity in adults, hypertension and coronary heart disease and the risk of colorectal tumors and dyslipoproteinemia [19], is closely related to carbohydrate consumption. It was shown that the amount of fiber in the modified menus was much higher than the recommended minimum, even though the energy content and carbohydrate content were lower. In this context, it should be considered that only 32% of men and 25% of women in Germany achieve a fiber intake of 30 g a day which is in line with the recommendations [1]. A higher amount of car-

bohydrates in the vegan menu shown is therefore not necessary.

The fulfilment of requirements for vitamins and minerals should be regarded in comparison with the German population as a whole, where e.g. only 79% of men and 86% of women consume the recommended intake of folate [1]. Calcium intake is usually critical across the total population in Germany [1] as well as in vegans [4, 17]. In the modified vegan menu, calcium intake is adequate – although this is highly dependent on the consumption of mineral water rich in calcium. In contrast to the general population, studies show that vegans are in fact mostly well supplied with fiber, vitamins B<sub>1</sub>, C, E, folate and iron [4, 17]. On the other hand, the supply of vitamin B<sub>12</sub> is particularly unstable in a vegan diet [4, 5, 17, 20]. Like in the general population, levels of iodine [5] and vitamin D [17] are often insufficient. A quantitative analysis of the amounts of these nutrients in the modified vegan menu is not possible. In a vegan diet, iodine is mostly consumed via a person's salt intake, which is not measured in the recipes of the canteen kitchen. In the case of vitamin B<sub>12</sub>, plant-based foods are not a reliable source and supplements are therefore recommended anyway [11, 21], so there was no use in recording intake amounts. The qualitative recommendations of the vegan checklist to consume foods enriched with vitamin D and vitamin B<sub>12</sub> (which are often also enriched with calcium) and to use iodized salt are aimed at improving the supply of these nutrients. In addition, the guests choosing a vegan meal should ideally be advised to consider supplementing their diet with vitamin B<sub>12</sub> [11]. Furthermore, the supplementation of vitamin D and/or increased exposure to sunlight in order to promote endogenous synthesis should be recommended [11] as well as the consumption of mineral water rich in calcium. It therefore seems reasonable that a sufficient supply of nutrients is possible. Regular medical checks are recommended for vegans nevertheless.

Besides the nutritional analysis, other advantages of a vegan diet should be emphasized. Indeed vegans – even when compared to ovo-lacto-vegetarians – have a reduced risk of obesity [6, 8, 17], hypertension [5–8], diabetes mellitus [6, 22], cardiovascular diseases [8, 9], cancer [8, 9, 23] and also a lower mortality rate as shown in cohort studies [24]. Considering the high prevalence of people who are overweight or obese in Germany [25], which in turn results in a higher comorbidity of the aforementioned diseases [26], one can conclude that raising public awareness could also lead to positive effects here. Even if the causes of the beneficial effects of a vegan diet are multifactorial (e.g. higher socioeconomic status), a meat-free and dairy-free option is an essential component of an optimal selection in public catering. In the context of the 'nudging' concept [27, 28], this would ensure that healthier food choices are accessible.

According to a study by MEIER et al. in 2015 [29], the costs of diseases which are caused by the consumption of saturated fatty acids (which are mostly of animal origin) amount to approximately 2.9 billion € in Germany in the year 2008 alone. It is therefore relevant to also look at this topic from the perspective of health economics. There are also ecological reasons to support increasing plant-based options, including those in public catering. When it comes to reducing nutrition-related greenhouse gas emissions, further studies by MEIER et al. identify a vegan diet as offering the greatest potential for reductions. For example, this could lead to a reduction of greenhouse gas emissions [30] and less land use [31]. A nutritionally balanced and tasty vegan meal option can therefore contribute to a healthy eating pattern that is adapted to individual tastes, preferences and needs. It can also encourage non-vegetarians and non-vegans to consider consuming a higher amount of plant compounds. This demonstrates the special role of public catering, which can reach people from all different environments.

## Limitations

This paper does not claim to present the only possible composition of a vegan meal plan. Nor can it be ruled out that a vegan meal plan which does not fulfil all the requirements of the vegan checklist could still provide adequate nutritional value. Furthermore, as with the DGE quality standards, bioavailability is not considered separately because eating patterns are highly complex and lunch only forms one part of a person's daily intake. Inspecting the actual recipes showed that plant-based alternatives to cream are widely used. It would therefore be conceivable to extend the checklist criteria within the category "fats and oils". It was not possible to consider the special nutritional needs of pregnant or nursing women, children, elderly and ill people.

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## Conflict of Interest

Ina Volkhardt was employed at the *Studentenwerk Leipzig* (student services organization) at the time of data collection and evaluation. The scientific work was carried out neither on behalf of the student services organization nor as part of the working hours and without financial reimbursement, but was permitted.

The other authors declare no conflict of interest.

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