Universal Meals:

Analysis of the concept regarding nutritional, social, economic aspects and development and sensory evaluation of four recipes

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by

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List of Abbreviations

ALA ..... alpha-linolenic acid
BLS ..... Bundeslebensmittelschlüssel
CHO ..... carbohydrate
DHA..... docosahexaenoic acid
EPA ..... eicosapentaenoic acid
FAO..... Food and Agriculture Organization of the United Nations
GFD..... gluten-free diet
GHG ..... greenhouse gas
LA..... linolenic acid
MUFA ..... monounsaturated fatty acid
PCRM..... Physicians Committee for Responsible Medicine
PUFA..... polyunsaturated fatty acid
RDA..... Recommended Daily Allowance
RE ..... retinol equivalent
SAFA..... saturated fatty acid
SD ..... standard deviation
UM..... universal meal
US ..... United States

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1. Introduction

1.1 Problem

For centuries, kitchen and dinner table have been significant places of social gathering. What started with the household revolving around the stove, today is continued in the form of business meals, dinner evenings or even just plain communal meals. However, nowadays getting everyone at the dinner table proves to be much more complicated. That is because of food allergies and intolerances being on the rise as well as our modern, more diverse multicultures, which include different eating restrictions from different religions. By offering meals only the meat-eating majority of people can eat, individuals with eating restrictions are not only deprived of the comfort of getting ready-to-eat meals, they are also deprived of the social aspects of a communal meal or may feel like a bother. A potential solution to eliminate this imbalance may be a type of meal everyone can enjoy: a **universal meal** (UM).

1.2 Aim & goal

This thesis aims to explain the idea of UMs, investigate their nutritional, social and economic value as well as sustainability and follow and explain the development of four UM recipes two of which are tested regarding their taste and appearance. Furthermore, it shows how to construct UMs in general and demonstrates that it is not as difficult as commonly perceived. A discussion on the meaningfulness of UMs will conclude this work.

1.3 Methods

To describe the many aspects and the relevance of UMs, the author will refer to current literature and statistics. The recipe development will be described from the experience the author made during the process and will be further complemented by a questionnaire on the taste and appearance of said recipes, used on a small sample (n=26) of students. To account for the sustainability of the UMs, the author will use a special free-to-use sustainability calculator and look into current literature.

The nutritional value of universal meals will be evaluated by means of literature research on vegan and gluten-free diets, including a look into the most critical nutrients. The economic value will be assessed briefly by looking at literature comparing costs and one best practice example which will furthermore include important aspects to judge the social impact of UMs. These will be supported by statistics and papers underlining the potential demand for UMs. Concluding this thesis will be an evaluation of UMs based on their social, nutritional, economical, ecological as well as sensory aspects.

1.4 Definition

The information given in this section is a summary of the information as received by the Physicians Committee for Responsible Medicine (PCRM) in 2018[1].

UMs are constituted by a set of meal guidelines that adhere to most dietary restrictions and should be able to be implemented anywhere food is served. While it is not possible to cover every dietary restriction, it is possible to cover the vast majority of them (PCRM, 2018). Table 1 will give an overview of these guidelines.

Table 1: Food avoided in UMs

Criteria	**Food to avoid**
Judaism	pork, shellfish
Islam	pork, alcohol
Hinduism	beef, meat, eggs
Vegetarian	meat, fish
Vegan	animal products
Lactose intolerance (many people of color)	dairy, lactose
Celiac disease/ non-celiac gluten sensitivity	wheat, rye, barley, triticale, contaminated grains
Other food allergies	peanuts, tree nuts, soy, mustard, sesame, celery, lupin, sulphites

[1] During the time of recipe development and writing this thesis, an updated version has been published by the PCRM at https://www.pcrm.org/good-nutrition/plant-based-diets/universal-meals-guidelines (accessed 11 March 2020). As the recipes were developed using the older version, the present thesis is based on the 2018 definition.

UMs must further adhere to six general principles:

1. **Acceptability**

   Appealing to people with a variety of dietary needs and traditions, and containing no offensive ingredients (e.g. “a little meat stock,” “a trace of peanuts,” etc.)

2. **Familiarity**

   Tried and true foods that have long been popular (e.g. breakfast oats, hummus, rice pilaf, etc.)

3. **Flexibility**

   Can be tailored and enhanced as desired (e.g. garlic hummus with roasted red peppers, rice pilaf with asparagus, bean tacos with salsa Mexicana)

4. **School-friendly**

   Meets school nutrition guidelines.

5. **Adaptability**

   Resilient enough to work in institutional settings (e.g. schools, airlines)

6. **Short-term**

   Designed for short-term use and not necessarily intended as optimal nutrition for extended periods. For example, recipes need not be low-sodium, nutritionally complete, vitamin B_{12}-fortified, etc.

2. Main body

2.1 Purpose and use

There are multiple reasons why the use of UMs may be beneficial to both customer and business. The two major aspects are the uses in regard to social bonds and in regard to economic efficiency.

The most important underlying base for the benefits and uses of UMs is their ability to cater to a vast majority of people. That includes people restricted by means of any criteria listed in Table 1 (see 1.4 Definition) as well as people with unrestricted diets. Table 2 portrays some approximates of the amounts of affected people.

Table 2: Amounts of people affected by UM criteria

Criterion	Percentage of US Americans	Source
Judaism	1.7-2.6	(Dashefsky and Sheskin, 2016, p. 175; Pew Research Center, 2013; Steinhardt Social Research Institute, Brandeis University, 2019)
Islam	1.1	(Besheer Mohamed, 2018)
Hinduism	1	(Daniel Cox, Robert P. Jones, 2016)
Vegetarian	5	(Zach Hrynowski, 2019)
Vegan	3	(Zach Hrynowski, 2019)
Food intolerances in general	10.8 (yet 19 believe they are intolerant)	(Gupta et al., 2019)
Lactose intolerance	36	(Storhaug et al., 2017)
Gluten avoidance	1	(Mardini et al., 2015)

2.1.1 Social aspects

As mentioned in section 1.1 there is an important social aspect to food since it is often eaten together. Indicating compatibility or acceptance, sharing a meal plays a crucial part in the forming of social bonds and peer acceptance (Fieldhouse, 1995, pp. 84–86). Moreover, it creates an opportunity to meet each other, socialize and exchange views. Knowing that, Danish artist Ólafur Elíasson created a canteen offering large tables and vegetarian meals for the staff to come together. The aim: for the colleagues not to lose touch with one another, stay in contact and exchange ideas and views (Rützler and Reiter, 2018, p. 43). Just like his canteen, many others tend to serve vegetarian meals in order to be able to serve most people.

While this practice has been considered appropriate for many years, the growing number of vegans, people with food intolerances and allergies (Du Toit et al., 2016), or religious dietary needs renders the simple vegetarian meal insufficient to meet the needs of everyone. Considering that, UMs would serve the purpose of catering to many different people more efficiently than just vegetarian meals.
An alternative method serving the same purpose is the free flow system, which enables customers to compose their own meals by fetching the different parts of it at different stations in e.g. a cafeteria. While this may be at least as inclusive as UMs[2], it takes up more space and requires a larger variety of ingredients and a larger amount of work depending on the number of foods to choose from. It is thus less ubiquitously applicable.

The mentioned social aspects do not only apply to a work or gastronomy setting. UMs could also be utilized when cooking for family members or social gatherings in general. Whenever a dietary restriction is unknown to the host, UMs can be a proper choice. UMs might also reduce effort, eliminating the need to make a specific meal for every restriction to be confronted with. This will be further elaborated from an economical point of view in the following paragraph.

2.1.2 Economic aspects

As mentioned before, UMs are suited to feed people whose dietary restrictions are unknown to the host. That does not only include private settings, it also applies to restaurants, canteens and more. For example, airlines are confronted with many different people with different restrictions due to culture, religion, intolerances and allergies as well as ethical choices. Using UMs as one of the two standard options would get rid of the need for the customer to declare their preference or restriction beforehand. And since UMs are suited for both people with and without dietary restriction(s), UMs enable businesses to serve many customer groups without requiring several different meal options. This could pave the way for a more efficient food-stock keeping and for less expenses due to spoilage. That is especially true since UMs are plant-based as will be explained in section 2.2 Nutritional value of universal meals.

[2] Provided there are enough options to suit the needs of all groups given by the UM criteria

The very same trait determines another benefit of universal meals: the lower cost. As a rule, plant-based products are cheaper than animal products, even when adjusted for the whole diet and/or protein content (Conforti and D'Amicis, 2000; Donati et al., 2016; Lusk and Norwood, 2009).

Seemingly farfetched but still considerable is the thought of work efficiency. People who get along well are more productive than those who don't (Evans and Dion, 1991; Jehn and Shah, 1997; Shah and Jehn, 1993; Zaccaro and McCoy, 1988). UMs allow everyone to eat together, thus improving the socializing process during meals. Considering the social worth of communal meals, eating together might actually improve work outcome. This has been discussed before (CBC News, 2016; Kniffin et al., 2015). Regarding the correlation between a company's social capital and performance (Badura, 2014), the thought seems valid.

2.2 Nutritional value of universal meals

As declared when defining UMs in section 1.4, UMs are supposed for short time use and thus do neither try nor need to fulfill requirements of a healthy and balanced diet. Still, the nutritional value of UMs will be examined in the following section to better assess the place they could or could not hold in one.

2.2.1 Nutritional risks of universal meals

Adding up all the restrictions mentioned in section 1.4 will result in a vegan, alcohol- and common allergen-free diet (see Figure 1: Venn diagram of UM criteria). The most common food allergens include milk, fish and shellfish, eggs, wheat (excluding gluten subsequently), peanuts, tree nuts, soy, mustard, sesame, celery, lupin and sulphites. Since lactose, eggs, fish and shellfish are already excluded in the vegan diet, their lack will also be included when examining the risks of a vegan diet. Out of the other factors, only wheat/gluten prove important to the nutritional status as will be explained in 2.2.1.2 Nutritional risks of a gluten-free diet. Since added to that no risks derive from an alcohol-free meal, only the two risk factors vegan and gluten-free will be examined further.

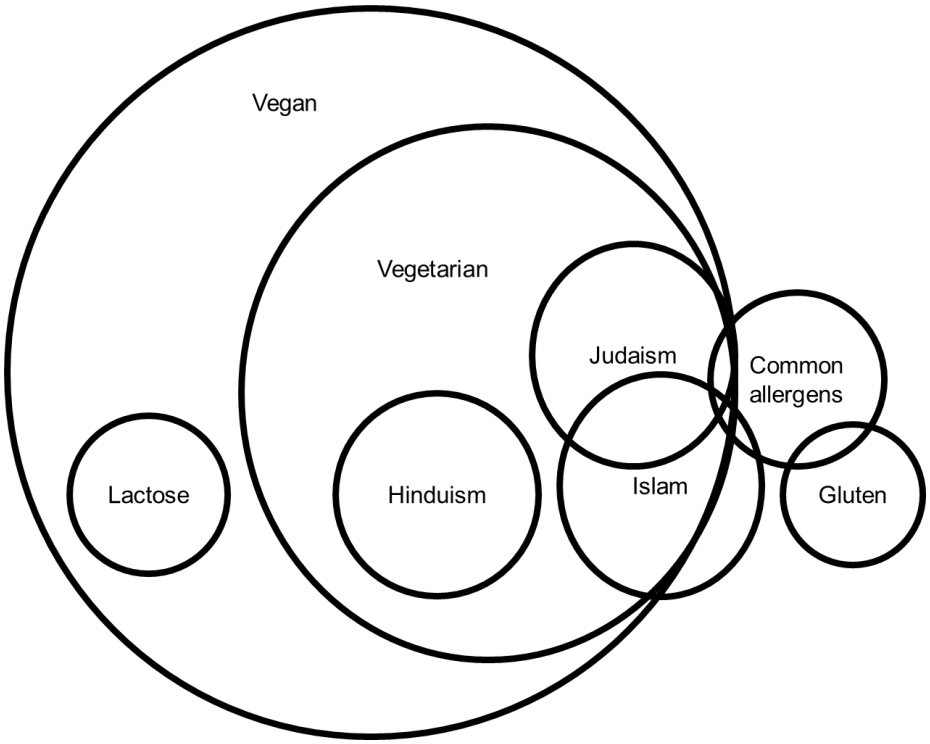

Figure 1: Venn diagram of UM criteria

2.2.1.1 Nutritional risks of a vegan diet

Vegan diets have been assessed many times. While some health or nutrition organizations deem them appropriate if well-planned (Position of the American Dietetic Association and Dietitians of Canada: Vegetarian diets, 2003), others do not publish such statements. One reason for that might be the diverse insufficiencies that may result from a non-supplemented and non-balanced vegan diet. These risks can result from different reasons. One being the lower level of certain micro-nutrients in plant-based products compared to animal products. Another one being the lower biological availability, meaning while the intake of a micronutrient might seem sufficient in amount, it may not be absorbed or used in the proper ratio. Typical (micro)nutrients that thus may lack in vegan diets (Crowe et al., 2011; Davey et al., 2003; Majchrzak et al., 2006) include:

Vitamin B2 (riboflavin)

Riboflavin is typically found in tree nuts, legumes, whole grain wheat and different vegetables (e.g. broccoli, kale) (DGE, 2016)[3]. Since tree nuts and wheat are excluded for being allergens, UMs are prone to being low in vitamin B2. By inclusion of adequate

[3] Deutsche Gesellschaft für Ernährung (German Nutrition Society)

dark vegetables such as e.g. spinach, kale, broccoli, fennel (Souci et al., 2016, pp. 380, 741, 757, 793) and correct procession, B2 levels could be raised though.

Vitamin B12 (cobalamin)

Cobalamin is produced by microorganisms and is typically found in animal products. That is why in general vegans need to supplement B12, even though there are minor levels of B12 in certain vegan foodstuffs such as sauerkraut and shiitake mushrooms (DGE, 2016). Generally, UMs will contain no to very little vitamin B12.

Vitamin D

Even though vitamin D is mainly produced by endogenous synthesis (Chan et al., 2009), nutritional levels are higher in the typical western diet than in a vegan one since the vitamin can also be found in certain animal products like egg yolk, fatty fish and cheese (BLS[4] 3.01). UMs might provide some (yet very little) vitamin D in its less bioactive form via e.g. mushrooms or avocado (Kofrányi and Wirths, 2013, p. 112). UMs (just as other meals) will not be able to provide the individual need for vitamin D.

Calcium

Plant-based products high in calcium include vegetables like broccoli and kale, nuts, legumes and soy products (DGE, 2016). UMs exclude nuts and soy products, lowering their potential mean calcium content.

Iodine

Iodine levels are highly dependent on the amount of fish and iodinated salt used. Thus, the amount of iodine in UMs will be determined mainly by amount and kind of salt used.

Zinc

In vegan diets, zinc is mainly provided by whole grain wheat, legumes, tree nuts (DGE, 2016) and soy (BLS 3.01). Applying UM criteria, only legumes are left. Extrapolating, UMs will be low in zinc content.

Long-chain n-3 fatty acids

Just like vitamin B12, n-3 fatty acids (FA) eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) can barely be consumed relying solemnly on plants. Instead, their preforms linolenic acid (LA) and α-linolenic acid (ALA) can be consumed.

[4] Bundeslebensmittelschlüssel (German Nutrient Data Base)

While vegans are observed to still reach the adequate blood levels of EPA and DHA, the reason is considered to be a higher conversion rate (Welch et al., 2010). This effect should not appear in the occasional consumption of UMs in an otherwise regular diet. Consequently, long-chain n-3 fatty acid levels will be relatively low in UMs.

2.2.1.2 Nutritional risks of a gluten-free diet

Studies indicate that a gluten-free diet (GFD) may lack in thiamin, calcium, magnesium, iron, potassium, zinc and dietary fiber (Golley et al., 2019; Thompson et al., 2005; Wild et al., 2010). Non-exhaustive lists of alternative sources for the discussed micronutrients are displayed in Table 3 (BLS 3.01; Souci et al., 2016) mit in die Quelle. Added to that, plant-based meals may also increase bioavailability of micronutrients (e.g. calcium) by containing certain soluble fibers (Tungland and Meyer, 2002).

Table 3: Sources for nutrients critical in the GFD fitted for UMs

Nutrient	**Source fitted for universal meals**
Thiamin	zucchini, carrot, beans, dried fruit, smoothies
Calcium	various berries, rhubarb, spinach, kale, cabbage, carrot, beans
Magnesium	various berries, dried fruit, spinach, kohlrabi, legumes
Iron	various berries, dried fruit, spinach, kale, zucchini, legumes
Potassium	various berries, dried fruit, rhubarb, spinach, salad, cabbage
Zinc	legumes, (rice, corn)[5]

As universal meals will consist primarily of gluten-free grains, legumes, potatoes, fruits and vegetables, the amount of dietary fiber should not be deficient. Fiber composition on the other hand is worth discussing: wheat and other gluten-containing grains are rich in insoluble fiber, which has been shown to increase faecal bulk and laxation (Fuller et al., 2016) and may be protective of colon cancer (Dahl et al., 2005; Reddy et al., 1989). These types of fiber are also found in gluten-free grains like rice or corn as well as legumes and in fruits and vegetables, though the content may be lower. Added to that, soluble fiber causes the majority of effects dietary fiber has on health (Fuller et al., 2016). These types of fiber are relatively higher in fruits and vegetables (Souci et al., 2016, pp. 555-660, 677-929, 933-1072). Still, compared to a meal with whole wheat, UMs will typically be relatively lower in insoluble and higher in soluble fiber.

[5] relatively low amounts of zinc

2.2.1.3 Conclusion: nutritional risks of universal meals

To conclude, UMs will typically be low in vitamin B2, B12, D, calcium, iodine, zinc and long-chain n-3 FA. They may furthermore be lower in insoluble fiber compared to whole wheat meals. Solemn consumption of UMs would lead to severe insufficiencies.

2.2.2 Nutritional benefits of universal meals

As UMs are plant-based, they share the benefits of a plant-based diet (Berkow and Barnard, 2006; Dinu et al., 2017) excluding benefits solemnly generated by the consumption of products containing soy, tree nuts or other common allergens. Examining the entirety of benefits from all the included foods (mainly legumes, vegetables, fruit) has already been done elsewhere (e.g. Aune et al., 2017; Li et al., 2017) and thus is unnecessary for the present work to do. Still, UMs share the key factors that cause the positive effects of plant-based diets on health (Clarys et al., 2014). These factors include:

Energy

In high contrast to ancient time, search for food is no longer a day-spending activity. Still, our evolutionary drive to eat what we can get, especially foods high in energy, remains. The aftermath is extensive. As many as 39% of adults are overweight, 13% obese (WHO, 2018); at high cost for individual health as well as entire healthy systems(Konnopka et al., 2011).
High in water and low in fat, plant-based meals are typically low in energy, providing a satiating alternative to the typical western diet.

Dietary fiber

A high content of vegetables, fruits and whole grains in food results in a high fiber content, which in turn provides many health benefits. Diets high in fiber are associated with lower rates of cardiovascular/artery diseases as well as lower risks of different types of cancer (Ma et al., 2018; Veronese et al., 2018; Zheng et al., 2018) and may reduce intestinal complaints (Moayyedi et al., 2014) and the risk for metabolic syndrome (Chen et al., 2017).

Fat profile

The more plant-based the diet, the better the fat profile. Indicated by lower levels of SAFA and higher levels of MUFA and PUFA, vegan and vegetarian diets prove to have a healthier fat intake profile (Davey et al., 2003).

Sodium

Plant-based diets are typically lower in sodium (Clarys et al., 2014; Tong et al., 2019). One possible reason might be that the majority of salt is provided by the food industry, i.e. highly processed products like sausage or convenience foods (He and MacGregor, 2010) which are consumed less in plant-based diets.

Nutrient density

Standing in contrast to the so-called “empty calories”, vegetables and fruit have been proven to be nutrient dense (Darmon et al., 2005; Di Noia, 2014). Supplying the body with important nutrients, plant-based dishes contribute to general health.

2.2.3 Conclusion: nutritional value of universal meals

If a person was to only consume UMs, they would develop an insufficiency in one or more vitamins and/or minerals as well as and long-chain n-3 FA. That said, the number and severity of insufficiencies depends strongly on the meals eaten as well as on the individual. UMs cannot be advised as a diet – but by their definition would never be in the first place. UMs are solely a meal form designed for short-term use. Individuals usually don’t have all dietary restraints and will have to take care of a balanced diet themselves. For example, a vegan might need to use other supplements (e.g. B12) than somebody with celiac disease (e.g. folic acid).

The occasional consumption of UMs may contribute to better health by the various properties mentioned and by shifting the individual diet in a plant-based direction (Derbyshire, 2016).

2.3 Sustainability

2.3.1 Sustainability of universal meals in general

According to the Food and Agriculture Organization of the United Nations (FAO), sustainable diets are those fitting the following criteria (Burlingame, 2012, p. 7):

- Are accessible
- Are economically fair and affordable
- Have a low environmental impact
- Are protective and respectful of biodiversity and ecosystems
- Contribute to food and nutrition security
- Are nutritionally adequate, safe and healthy
- Contribute to healthy life for present and future generations
- Are culturally acceptable

This definition does not apply to UMs for the very reason that UMs are not a diet but a meal form designed for short-term use. Thus, they cannot be a sustainable diet. However, this definition is the closest thing to give criteria for sustainable dishes. As nutritional adequacy and such have already been assessed (see 2.2 Nutritional value of universal meals) and cultural acceptance is given by the definition of UMs (point 1 of the UM criteria, “Acceptability”, see 1.4 Definition), they will not be discussed here. Other than these, each criterion will be discussed in the following paragraphs.

UMs are not accessible as a meal form themselves yet, though they might be in the future once the concept is more established.

While most UMs should be affordable due to their plant-based nature as discussed in section 2.1.2 Economic aspects, economical fairness is not determined by the meal itself but by the quality of ingredients and trade (meaning e.g. organic foods, fair wages). Thus, economic fairness is highly dependent on the vendor but possible in general. Added to the relatively low cost of plant products making UMs affordable might one day come subventions. One indication is that plant-based diets are being advised to be supported financially in the Global Sustainable Development Report 2019 (AFFAIRS, 2019, p. 71). To conclude: whether a UM is economically fair and affordable is not determined by the UM itself but by businesses. UMs per se are neither economically fair nor unfair.

That leaves the criteria of low environmental impact, a protective and respectful behavior towards biodiversity and ecosystems, and the contribution to food and nutrition security. Since all these criteria are fit by UMs being vegan and thus plant-based, they shall be answered simultaneously:

Plant-based diets have been shown to have the lowest environmental impact (Hallström et al., 2015; Reijnders and Soret, 2003; Scarborough et al., 2014), especially the vegan diet (Baroni et al., 2007). That is because plants are extraordinarily lower in greenhouse gas (GHG) emissions and land use than animal products (Poore and Nemecek, 2018). To put it into perspective: up to 14.5% of man-made emissions are estimated to be caused by livestock (World livestock, 2018, xxix).

Of course, environmental impact is also highly dependent on degree and kind of processing, preparation, and transporting distance. Still, using products from vegetable instead of animal origin has a very dominant effect (Carlsson-Kanyama et al., 2003).
Plant-based diets are also shown to consume less land, energy and water (Pimentel and Pimentel, 2003), contributing to less damaged biodiversity and ecosystems (Stoll-Kleemann and Schmidt, 2017) and thus positively impacting food and nutrition security.

Since all criteria could be met, UMs may be executed sustainably.

2.3.2 Sustainability of the developed meals

To rate the sustainability of the developed recipes the NAHGAST calculator[6] was used, a free tool for calculating the ecological and social cost as well as the nutritional value of meals. It does so by using data on the specific ingredients listed in a custom database. If the database did not include a specific ingredient, it was replaced with a similar one, e.g. coconut flakes were replaced with a larger amount of coconut milk (to compensate for its water content).
Since the NAHGAST calculator is supposed to only be used for main courses (see Appendix I), solely one of the developed recipes (a lentil curry) could be checked on as the other developed recipes do not qualify as main courses.

The calculator allows for marking some ingredients as fair trade or not, ecological or not and sometimes the distance in which the product has been produced. All

[6] Available at www.nahgast.de/rechner (Accessed 05 March 2020)

ingredients were calculated in a worst-case-manner to avoid unprofessionally favorable presentation.

To make up for the calculator's weakness of comparing entered meals to a standard portion size (see Appendix I), entered portion sizes were always 650 g (22.9 oz) disregarding their actual portion size. Otherwise, smaller portions would have gotten better ratings than they are supposed to.

The detailed results of the calculation for environmental and social cost are displayed in Tables 4 and 5[7]. Total environmental and social scores are ranked on a 6-point scale with 6 being the most desirable value. The individual influencing factors that constitute the total score are ranked on a 3-point scale with 3 being the most desirable value.

The calculation results for nutritional value are not displayed as the nutritional value has already been discussed in a more detailed matter in section 2.2 Nutritional value of universal meals. The nutritional composition of the developed recipes is displayed in Table 9 in section 2.4.2 Finished recipes.

Table 4: Environmental score of UM lentil curry as determined by the NAHGAST calculator

Environmental score	
Influencing factors	
Cost of materials	
GHG emissions	
Water demand	
Land requirements	

Table 5: Social score of UM lentil curry as determined by the NAHGAST calculator

Social score	
Influencing factors	
Animal welfare	
Fair trade quota	

[7] Tables 4 and 5 have been created based on the result tables displayed when using the NAHGAST calculator.

2.4 Recipe development

The many dietary restrictions exclude a lot of common meals. Every dish made with wheat flour, eggs, dairy, or meat is excluded. This includes common household staples such as pasta. Since that sounds like the end of culinary pleasure to many people, the main goal was to create tasty and optically appealing meals that would match the UM criteria. To further show that an alternative meal form that “fits all” does not have to be expensive or artificial, sub-goals included making the meals affordable and to stick to common ingredients. The latter of which is also included in the general UM criteria (see 1.4 Definition).

2.4.1 Construction

When introducing people to the idea of UMs as a meal free of meat, milk, wheat/gluten and other allergens, their first guess of what is left to eat includes solely water. Other popular reactions include the question, if it was going to look or taste any different from just grey mush. That is because people tend to forget about the things they are not confronted with at the moment. It is a simple psychological rule called WYSIATI: What You See Is All There Is (Kahneman, 2012, pp. 112–116). The typical western diet relies on meat, milk, cheese and other animal products as well as on wheat for bread, pasta and many others. This exemplifies why exclusion of these ingredients from UMs make people wonder about what they could possibly be made of – simultaneously forgetting about all of fruits and vegetables, about gluten-free grains like corn or rice and about legumes.

Table 6 is the result of a first brainstorming on ingredients from when the recipe development had just begun. While the first two columns are quite self-explanatory, the third one was used to keep track of foods that are strong in taste and could be a center component of the dish. While the table was used as a broad orientation it is also able to display a tiny fraction of the wide variety of fruits and vegetables to choose from.

Table 6: Brainstormed table of possible ingredients for UMs

Fruit	**Vegetables/Legumes**[8]	**Strong taste**
Pineapple	Sweet potato	Tomato
Mango	Potato	Coconut
Date	Cabbage (many different kinds)	Orange
Plum	Spinach	Lime
Pear	Pumpkin	Lemon
Apple	Cucumber	Fennel
Apricot	Cauliflower	Garlic
Peach	Beans	Celery
Kiwi	Broccoli	Ginger
Pomegranate	Zucchini	…
Cherry	Millet	
Strawberry	Peas	
Raspberry	Chickpeas	
Blueberry	Eggplant	
Banana	Paprika	
Nectarine	Carrot	
Grapes	Turnip	
Melon	Beetroot	
…	Onion	
	…	

A different and more structured approach for looking at the ingredients is to group them by their technological use as done in Table 7. It was created in collaboration with trained kitchen staff.

Table 7: Systematic table of possible ingredients divided by technological use

Taste	**Liquid**	**Binding agent**
Black beans	Grape juice	Flaxseeds
Garlic	Pomegranate juice	(Corn) starch
Onions	Vinegar	Pectin (e.g. apple, berries)
Tomatoes (especially dried)	Lemon juice	Potatoes
Mushrooms	Lime juice	…
Pumpkin	Orange juice	
Carrots	Oil	
Parsnips	…	
Beetroot		
Spinach		
Cabbage, roasted		
Seeds		
Olives		
Algae		
Chili		
…		

[8] Due to their flatulent effect, legumes and vegetables like onions etc. might be unfitted for some customer groups.

As a general rule, UMs can be constructed using one main component for satiety (e.g. potatoes, rice, polenta, lentils), then adding vegetable or fruit for more taste variances or volume and a main taste component. For example, boiled rice with peas, carrots and a creamy paprika sauce would conclude an UM. Please refer to the “How to build a universal meal” sheet in Appendix VII for a more illustrated guide.

2.4.2 Finished recipes

Using the Tables 6 and 7, the following 4 dishes were developed:

1. Lentil curry
2. Balsamic tomatoes
3. Coconut ice cream with raspberry sauce
4. Fruit pudding

Since the process of preparing UM salads and soups is quite simple, the recipes chosen for this project include one main course, one side dish, and two desserts. The recipes were also chosen in a way to show multiple possible applications. The lentil curry could be used universally, the coconut ice cream would suit restaurants and the fruit pudding would work in a canteen setting.

The development itself consisted of a lot of trial and error, of strategically combining fitting ingredients and of reusing already known methods of food preparation.

The recipes match all UM criteria. They do not contain any of the to be avoided ingredients and furthermore adhere to the six principles mentioned in section 1.4 Definition:

1. **Acceptability**

   No (traces of) offensive ingredients are used in the meals.

2. **Familiarity**

   The base dishes are very common: curry, dried tomatoes, ice cream and pudding.

3. **Flexibility**

   All the recipes can be varied widely, e.g.:

   - pumpkin lentil curry, vegetable lentil curry
   - dried tomatoes, thyme flavored baked tomatoes
   - coconut ice cream with glazed oranges, coconut ice cream with chocolate chips
   - orange pudding, mango pudding, raspberry pudding, banana pudding

4. **School-friendly**[9]

   The following section will analyze if the lentil curry matches school guidelines. The other recipes are not analyzed here for they do not qualify as either lunch or breakfast which are discussed within school nutrition guidelines.

   Referring to the Nutrition Standards in the National School Lunch and School Breakfast Programs of the U.S. Department of Agriculture, demands concern either meal composition or the total composition of the meal offer (Department of Agriculture Food and Nutrition Service, 2012). In general, the guidelines ask for:

   1. an increased availability of: fruits, vegetables, whole grains, fluid fat free/low fat milk
   2. the meals to be low in: sodium, saturated fatty acids (SAFA), trans fatty acids (TFA)
   3. the meals to supply an appropriate amount of calories
   4. the meals to be nutrient dense
   5. the meals to reflect the latest “Dietary Guidelines for Americans”[10]

[9] This criterion has been removed in the updated definition available at https://www.pcrm.org/good-nutrition/plant-based-diets/universal-meals (accessed 11 March 2020).

[10] Since the Dietary Guidelines for Americans refer to the whole eating pattern throughout life, a single meal like in this instance the lentil curry cannot reflect them. Thus, fulfilling this criteria will not be discussed

Some of these requirements vary depending on the students' age/grade group. The first point does not completely apply to UMs, since they are not foodstuff offered on the side. Still, due to their plant-based nature, UMs could easily provide fruits and vegetables. While they cannot provide whole grain wheat or other grains containing gluten, they can include other whole grains, e.g. rice. They cannot however provide cow milk in any form.

The amount of sodium can be varied greatly by how much salt is added to a dish and thus be modified to fit the different groups. See Table 8 for an adjusted version of the dietary specifications table given by the U.S. Department of Agriculture (Ibid, p. 4102).

Table 8: Dietary specifications for school lunches

Daily Amount Based on the Average for a 5-Day Week (Lunch)			
	Grades K-5	Grades 6-8	Grades 9-12
Min-max calories (kcal)	550-650	600-700	750-850
Saturated fat % of total calories	< 10	< 10	< 10
Sodium (mg)	≤ 640	≤ 710	≤ 740
Trans fat (g)	0	0	0

Based on a calculation using EBISpro, a software able to calculate nutritional values of meals, 400g (14.1 oz) of the Lentil curry with 80g (2.8 oz) of rice (uncooked) provide 615 kilocalories, with SAFA making up 5.3 % of total calories, 1646.3 mg of Sodium and no TFA. Clearly, the sodium level exceeds the recommendations. This is due to the amount of salt but also the way EBISpro calculates. The salt dismissed when draining the water from cooking the lentils is still included in this calculation. Thus, the calculated amount of sodium does not match the actual one.

Considering the plant-based ingredients and low amount of added fat, salt and sugars, the lentil curry's nutrient density ought to be appropriate. Since there are no specific guide values for nutrient density, this short summary will have to suffice.

Fulfilling all relevant guide values, the lentil curry meets the Nutrition Standards in the National School Lunch and School Breakfast Programs of the U.S. Department of Agriculture. Of course, that does not mean that the lentil curry

would fit all school guidelines, let alone all vegan, alcohol- and allergen-free meals fulfilling just the American ones. But it does show that it is possible to fulfill them with a kind of meal as restricted as this one.

5. **Adaptability**

   Except for the coconut ice cream, all dishes are easy to handle. The coconut ice cream is prone to melting, but as long as it can be cooled, it too is resilient enough to work inside aforementioned settings (e.g. schools).

6. **Short-term**

   The recipes were not constructed with the aim of a high nutritional value. For interest, their nutritional composition is displayed in Table 9. Values and percentages were rounded and may thus exceed 100%.

Table 9: Nutritional composition of the developed recipes

	kcal	**Protein (g)**	**CHO (g)**	**FA (g)**	**SAFA (g)**	**MUFA (g)**	**PUFA (g)**
100g lentil curry	83.3	5.4 (27 E%)	12.4 (61E%)	1.2 (13E%)	0.7	0.1	0.2
100g coconut ice cream with raspberry sauce (9:1)	217	1.5 (3 E%)	13.3 (25 E%)	17.8 (74 E%)	17	/	/
100g fruit pudding (peach)	87.6	0.6 (3 E%)	20.6 (96 E%)	0.1 (2 E%)	0	0	0
100g balsamic tomatoes	51.9	1 (8 E%)	5.3 (44 E%)	2.7 (48 E%)	0.3	1.2	0.7

The finished recipes are attached in Appendix VI for free use. A digital version in the form of an excel sheet can be obtained by sending an inquiry to mail@hannahehlert.de. Due to their ability to automatically calculate the amounts of ingredients based on portion size and volume, they might be more helpful than the printed version included in the present work.

Of course, four recipes alone cannot show the immense variety there is to UMs. To demonstrate, the following list consists of a few further meal ideas:

- Rosemary polenta sticks with fig-onion chutney
- Thyme potatoes (with a mix of potatoes and sweet potatoes)
- Red cabbage with orange
- Various antipasti
- Lentil/polenta/vegetable patties
- Falafel
- Hash browns
- Polenta balls
- Carrot dip
- Hummus
- Stuffed peppers
- Mashed potatoes
- Risotto
- Rice sweet-and-sour
- Chili sin carne
- Potato broccoli gratin
- Fried asparagus on strawberry salad
- Rice noodle lentil salad
- Stuffed rice balls
- Pomegranate salad
- Rainbow salad
- Rice noodle salad
- Rice salad with pumpkin
- Potato salad
- Wraps (in a corn tortilla)
- Polenta
- Ratatouille
- Soups (pea soup, pumpkin soup, potato soup, …)
- Cinnamon apricots
- Rice pudding with fruit
- Chocolate pudding
- Baked persipan pears
- White cabbage chutney with cranberries
- Beetroot spread

2.4.3 Evaluation

To check on the recipes' quality (i.e. taste, appearance and wanting to eat them again), 35 university students were recruited to taste and rate two of the meals, the lentil curry and the coconut ice cream with raspberry sauce. A questionnaire was built to answer the key questions: "Does it taste and look good?", "Would the person want to eat it again?" and "Which aspects of the taste could be improved?".

2.4.3.1 Method

To rate the taste and appearance of each dish, a 5-point Likert scale (“very bad” to “very good”) was used. To rate saltiness, sweetness and spiciness, a 5-point just-about-right scale (“much too little” to “much too much”) was used. Added to that, participants were able to note further comments in a blank field. They were furthermore asked for their sex, age and if they followed a certain diet (e.g. vegan, gluten-free, vegetarian). Please refer to the Appendixes IV and V to see the questionnaire in its original state (German) as well as translated into English.

2.4.3.2 Participants

To recruit participants, ten posters[11] were hung up in the university asking to register via email. A total of 35 students were recruited with nine of them dropping out by not appearing. The other 26 participants completed the questionnaire without further drop outs. The meals were eaten together at noon in a time span of 30 minutes in-between lectures.

The majority of participants were female (76.9%) as opposed to a male minority (23.1%). The mean age was 22.6 years (SD 3.5) and roughly 31% followed a special diet (11.5% vegan, 15.4% vegetarian, 3.8% flexitarian).

2.4.3.3 Results

The dishes’ ratings of saltiness, sweetness and spiciness are displayed in Table 10. While the coconut ice cream with raspberry sauce received a perfect score, opinions differed on the lentil curry. The majority of participants experienced the different aspects as just right, yet saltiness and spiciness lack intensity to some of the participants (roughly 15 – 19%). A possible solution to that would be to offer free salt and pepper or maybe other hot spices for the person to adjust their dish individually.

[11] See Appendixes II and III for German and English version

Table 10: Ratings of saltiness, sweetness and spiciness for UMs lentil curry and coconut ice cream with raspberry sauce

	Lentil curry			Coconut ice cream with raspberry sauce		
	Saltiness	Sweetness	Spiciness	Saltiness	Sweetness	Spiciness
Much too little	0 %	0 %	7.7 %	0 %	0 %	0 %
Too little	15.4 %	7.7 %	19.2 %	0 %	0 %	0 %
Just right	**80.8 %**	**92.3 %**	**69.2 %**	**100 %**	**100 %**	**100 %**
Too much	3.8 %	0 %	3.8 %	0 %	0 %	0 %
Much too much	0 %	0 %	0 %	0 %	0 %	0 %

Results of the total rating of taste and appearance are displayed in Table 11 as well as illustrated in Figure 2. Both aspects were rated positively for both dishes by almost all participants with taste getting a better score than appearance. Mean ratings are identical for both participants who follow a special kind of diet and those who do not (see Table 11 for the mean values), showing the meals can be enjoyed not only by those who do follow a restricted diet but by everyone.

Positive scores in both taste and appearance refute the fear of grey mush as described in section 2.4.1 Construction.

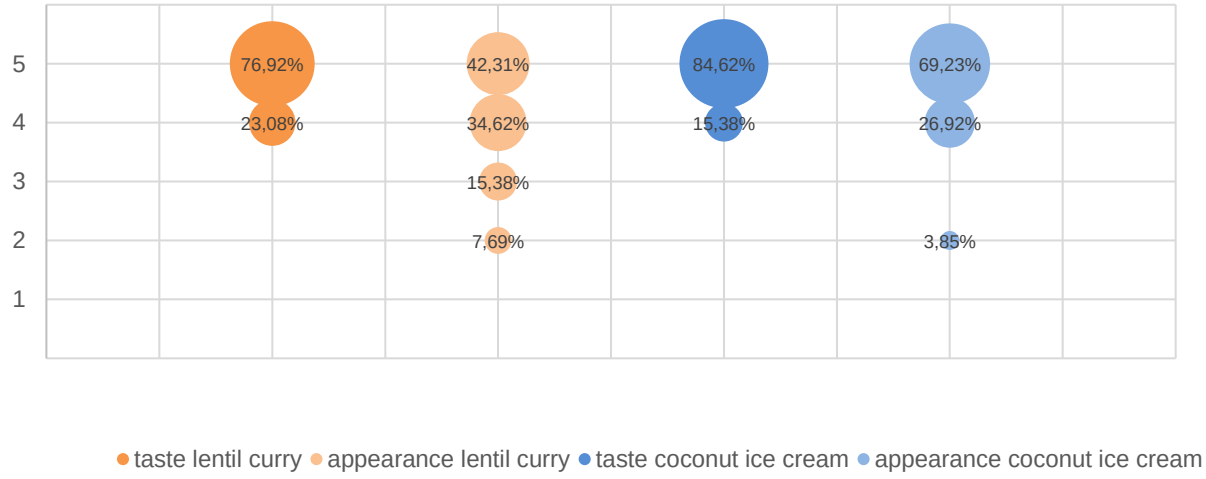

Figure 2: Ratings of taste and appearance for UMs lentil curry and coconut ice cream

Table 11: Ratings of taste and appearance for UMs lentil curry and coconut ice cream with raspberry sauce

	Lentil curry			Coconut ice cream with raspberry sauce		
	Average rating	SD	Mean	Average rating	SD	Mean
Taste	4.77	0.43	5	4.85	0.37	5
Appearance	4.12	0.95	4	4.62	0.70	5

The lentil curry received a total of nine comments (equaling 34.6% of the participants) of which three (equaling 11.5% of the participants) were suggestions for improvement, namely asking for a fresh component along the dish (like a salad), asking for a little less onion and asking for a little more tomato. The other comments were praise about good taste and pleasant mouthfeel.

The coconut ice cream with raspberry sauce received a total of 14 comments (equaling 53.9% of the participants), of which one (equaling 3.8% of the participants) was a suggestion for improvement, namely suggesting to increase sourness a little. The other comments were praise about good taste and smooth and creamy mouthfeel.

For the lentil curry, 96.2% of the participants answered they would like to eat the dish again. For the coconut ice cream with raspberry sauce, 100% of the participants answered they would like to eat the dish again.

To draw a conclusion, both meals were greatly accepted and rated positively by the participants. They both rank highly in quality of taste and appearance. The tendency to want to eat the dishes again indicates the recipes could be a valuable addition to menus/meal offers and the likes.

3. Evaluation

Through the course of this thesis, UMs have been shown to not only be unharmful to health but actually be able to add to a healthy diet. They have furthermore been shown to be inclusive, thus supporting a good social climate. This in turn may increase work and personal performance. UMs are cost-effective and do not necessarily deprive the consumer from culinary pleasure. Rather, they may be tasty and optically appealing.

4. Discussion

By their 2018 definition, UMs are designed for short term use and e.g. need not be low in sodium. This stands in contradiction to them meeting school nutrition guidelines, which specifically ask for the dishes to be e.g. low in sodium. This might be one reason as to why the criterion has been removed in the updated definition.

While UMs claim to be food everyone can enjoy, they do not take every intolerance into account, e.g. histamine intolerance.

As for the affected people, there is room for discussion: while 10.8% of US adults have food allergies, 19% believe they have one (see Table 2: Amounts of people affected by UM criteria). The resulting behavior has been discussed to be potentially unhealthy. UMs would also cater to the false beliefs of these people. Whether this is positive or negative is subject to ethical discussion.

UMs have been shown to be possible to execute but practicability has not been assessed. For example, to be truly free of allergens, there would need to be a separate kitchen aisle just for universal meals. Ingredients would have to be kept in mind, e.g. French fries would not be an UM anymore if they were fried in animal fat. Thus, effort for UMs does not end at recipe development. This may be critical for UMs since the author believes one of their biggest barriers is going to be rejection caused by unfamiliarity. Every further obstacle may thus reduce the likeliness of UMs being applied. Added to that, the free flow system might be more adequate in some settings.

UMs might also be rejected due to their alleged flatulent nature. This of course depends on the ingredients used in the specific dishes.

In the present work, the potential of UMs to support health has been shown by comparing them to plant-based diets. But UMs are not a form of diet; they are a form of meal. This makes assessing them for any properties hard – especially since there is no large set of recipes or data on them yet.

5. Concluding observations

UMs do have a great potential to add to togetherness, sustainability and economic efficiency. Seeming complicated at first, they are more straightforward once the individual parts have been summarized.

Not being a cook or even a cooking enthusiast, developing recipes proved to be hard for the author. Still, multiple recipes have been generated from this work with two of them having been evaluated very positively. Based on that experience, there may be great opportunities for UMs to cover a large variety of tasty and appealing meals if they are developed by appropriate people.

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Appendix I: Email exchange on the NAHGAST calculator

[25.02.2020, 10:12] Melanie Speck:

Liebe Frau Ehlert,

die Portionsgröße errechnet sich aus der Angabe „wieviele[sic] Portionen“ und dann aus der eingegebenen Menge an Lebensmitteln pro Rezept.

Für die Sustainable Level nehmen wir einen Durchschnittswert von 650g an, das läuft aber sozusagen „nur imHintergrund“[sic] mit. Diese Funktion soll auch bald „variabel“ sein.

VG Melanie Speck

[25.02.2020, 11:37] Hannah Ehlert:

Hallo Frau Speck,

lieben Dank für die Info! Das würde dann bedeuten, dass ein Nachtisch der beispielsweise 150g wiegt unverhältnismäßig besser beurteilt würde? Also für eine sinnvolle Auswertung müsste ich die Portion auf 650g erhöhen?

Viele Grüße

Hannah Ehlert

[25.02.2020, 11:45] Melanie Speck:

Wir beziehen uns aktuell nur auf die Hauptmahlzeit, die Bilanzierung von einem Nachtisch ist so nicht vorgesehen,

VG M Speck

[25.02.2020, 11:45] Hannah Ehlert:

Okay, und wenn ich eine Hauptmahlzeit habe, die 400g wiegt, dann sollte ich sie auf 650g hochskalieren?

VG Hannah Ehlert

[05.03.2020, 13:25] Melanie Speck:

ja

Appendix II: German recruitment poster

Mittagessen für umme

Du bist am 11.12.2019 in der FH?
Du hast Lust auf Linsencurry und Kokos Eis?

Dann komm doch um 11:45 zum FoodLab (D414)!
Du isst 2 Gänge, gibst deine Meinung ab,
und bist pünktlich in der nächsten Vorlesung.

Anmeldungen oder Fragen gerne an:
hannah.ehlert@fh-muenster.de

Innovationsraumprojekt von Hannah Ehlert, betreut durch Prof. Dr. Guido Ritter

Appendix III: English recruitment poster

Lunch for free

You're at the university on 11. dec 2019?
You feel like having lentil curry and coconut ice cream?

Then why don't you come visit the FoodLab (D411)!
You'll have two courses, rate them and be on time for the next lecture.

Please send registrations or questions to:
hannah.ehlert@fh-muenster.de

Project of the innovations room by Hannah Ehlert, supervised by Prof. Dr. Guido Ritter

Appendix IV: German questionnaire

Geschlecht: ☐ m ☐ w ☐ d Alter: _____

Fragebogen Bewertung zweier Gerichte

Im Folgenden sollen 2 Gerichte auf ihre sensorische Qualität hin bewertet werden. Ihre Angaben sind anonym und werden einzig und allein zum Zweck der Qualitätsbeurteilung der Gerichte verwendet.

Falls Sie eine bestimmte Ernährungsweise befolgen (z.B. vegan), geben Sie diese bitte an: _____

Gericht 1: Linsencurry

	sehr schlecht	etwas schlecht	neutral	etwas gut	sehr gut
Wie gut hat Ihnen das Gericht geschmeckt?	☐	☐	☐	☐	☐
Wie gut hat Ihnen das Aussehen gefallen?	☐	☐	☐	☐	☐
	viel zu schwach	etwas zu schwach	gerade richtig	etwas zu stark	viel zu stark
Die Salzigkeit war…	☐	☐	☐	☐	☐
Die Süße war…	☐	☐	☐	☐	☐
Die Schärfe war…	☐	☐	☐	☐	☐
Ich würde dieses Gericht wieder essen wollen:	ja ☐			nein ☐	
Sonstige Anmerkungen:					

Gericht 2: Kokoseis auf Himbeerspiegel

	sehr schlecht	etwas schlecht	neutral	etwas gut	sehr gut
Wie gut hat Ihnen das Gericht geschmeckt?	☐	☐	☐	☐	☐
Wie gut hat Ihnen das Aussehen gefallen?	☐	☐	☐	☐	☐
	viel zu schwach	etwas zu schwach	gerade richtig	etwas zu stark	viel zu stark
Die Salzigkeit war…	☐	☐	☐	☐	☐
Die Süße war…	☐	☐	☐	☐	☐
Die Schärfe war…	☐	☐	☐	☐	☐
Ich würde dieses Gericht wieder essen wollen:	ja ☐			nein ☐	
Sonstige Anmerkungen:					

Vielen Dank für Ihre Teilnahme!

Appendix V: English Questionaire

sex: ☐ m ☐ f ☐ d age: _____

Questionnaire Rating of Two Dishes

Below, two dishes are supposed to be rated on their sensory quality. Your answers are anonymous and will be used only to evaluate the quality of the meals.

Please indicate, if you follow a special diet (e.g. vegan): _____

Dish 1: Lentil Curry

	very bad	a little bad	neutral	a little good	very good
How good did the dish taste?	☐	☐	☐	☐	☐
How good did the dish look?	☐	☐	☐	☐	☐
	much too little	too little	just right	too much	much too much
The saltiness was…	☐	☐	☐	☐	☐
The sweetness was…	☐	☐	☐	☐	☐
The spiciness was…	☐	☐	☐	☐	☐
I would like to eat this dish again:	yes ☐			no ☐	
Other comments:					

Dish 2: Coconut Ice Cream with Raspberry Sauce

	very bad	a little bad	neutral	a little good	very good
How good did the dish taste?	☐	☐	☐	☐	☐
How good did the dish look?	☐	☐	☐	☐	☐
	much too little	too little	just right	too much	much too much
The saltiness was…	☐	☐	☐	☐	☐
The sweetness was…	☐	☐	☐	☐	☐
The spiciness was…	☐	☐	☐	☐	☐
I would like to eat this dish again:	yes ☐			no ☐	
Other comments:					

Thank you very much for participating!

Appendix VI: Recipes

The original, scalable excel sheet recipes can be obtained by sending an inquiry to mail@hannahehlert.de.

Balsamico tomatoes
10 portions. 150g/portion Total amount 1.5kg

%	Ingredients	kg	Preparation
84.7	Tomatoes	1.271	Cut in half
8.4	Oil	0.126	
6.3	Balsamico	0.095	
0.2	Salt	0.003	
0.4	Sugar	0.006	Mix with salt, balsamico, oil
			Cover tomatoes with sauce
			Bake for 15-20 minutes, 180°C circulating air
100		1.5	
	Baked produce	1.245	
	Water (washing tomatoes)	2.54	

Coconut ice cream[12]

10 portions. 150g/portion Total amount 1.5kg

%	Ingredients	kg	Preparation
89.5	Coconut milk	1.343	
10.5	Sugar	0.158	Mix, stir until smooth
			Freeze
			Mix smooth
100		1.5	

Raspberry sauce

10 portions. 10g/portion Total amount 0.1kg

%	Ingredients	kg	Preparation
90.9	Raspberries (frozen or fresh)	0.107	Thaw if frozen
9.1	Powdered sugar	0.009	Mix with raspberries
			Puree
			Pass through a sieve
100		0.100	

[12]In earlier stages of the development, the ice cream was served with caramelized oranges. Raspberries were originally just for decoration but proved to be tastier in combination with the ice cream and did not stick to the plates like the oranges did.

Lentil curry

10 portions. 300g/portion Total amount 3.0kg

%	Ingredients	kg	Preparation
32.6	Lentils. red (0.978kg uncooked)	1.956	Cook soft (10-12 minutes). put aside
35.8	Onions (1.074kg with skin)	0.977	Chop down
1.4	Ginger	0.042	Finely grate, roast with onions
1.4	Coconut rasp	0.042	
0.2	Cumin	0.006	Roast for 1 minute with coconut rasp
27.1	Skinned tomatoes	0.813	Add to the boil. simmer for 5 minutes
0.2	Tumeric	0.006	
1.3	Salt	0.039	Add salt and tumeric to lentils
			Simmer for 10-15 minutes
100		3.0	Optional: serve with rice
	Garam masala	0.006	Season at the end
	Coriander (powder)	0.004	Season at the end
	Cooking water	6.521	
	Oil for roasting	0.051	

Fruit pudding

10 portions. 150g/portion Total amount 1.5kg

%	Ingredients	kg	Preparation
86.7	Fruit juice at option	1.301	Bring to the boil, take off hotplate
6.9	Sugar	0.104	
6.4	Custard powder/starch	0.096	Cream smooth with sugar and juice
			Add to the boiling juice while stirring
			Stir, avoid lumps
			Let cool down
100		1.5	

Appendix VII: Infosheet “How to build a universal meal”

How to build a universal meal

Use the following steps in your preferred order to build your own universal meal.

1. Choose a main ingredient for satiety

What do you want to cook? Mashed potatoes? Lentil curry? Creamy polenta? Rice balls? Choose a main ingredient from potatoes, legumes, rice and corn or polenta and think about the form it should take.

2. Add fruits and vegetables

What do you want alongside your satiating component? Should the lentil curry have onions or not? Maybe add sauce to your rice balls. How about peas with your mashed potatoes?

3. Put a cherry on top

Refine your meal by giving it the extra little something. Maybe your coconut ice cream would work great with raspberry sauce, caramelized carrots would add to your mashed potatoes or a dash of lime is just what your sauce is missing.

Please avoid adding any of the following to your dish:
Wheat, gluten, soy, peanuts, tree nuts, mustard, sesame, celery, lupin, alcohol, animal produce

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For questions or inquiries please contact
mail@hannahehlert.de