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Nutritious lentil and rice meal for sustainable vegan and pescatarian diet

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Abstract. Urbanization has been accompanied by changes towards diets that have placed increased pressure on the environment and human health. Shifting diet from beef towards less-impactful proteins is the most important policy goal for dietary sustainability in 2050. Fish can also help to shift to lower emission diets, fish-eaters have nearly the same emissions profile as strict vegetarians. The aim of this study was to develop quick preparation lentil and rice meals that would be suitable for a sustainable vegan and pescatarian diet and to analyse and compare their nutritional values. Sample nutritional values were calculated according to raw material nutritional values. Results show that if most raw materials are plant-based there is no significant difference between vegan and pescatarian quick preparation meal sample nutritional values other than minerals and vitamins. Vegan quick preparation meal sample which contains green lentils has higher iron content comparing to pescatarian quick preparation meal which contains red lentils and freeze-dried salmon powder and has higher vitamin B1, B3 and B6 content.

Key words: lentils, pescatarian, rice, sustainable diet, vegan.

INTRODUCTION

The demand for protein source foods has increased over last few years. As interest for protein is growing it is expected for plant-based protein product market to grow significantly (Ismail et al., 2020). Some of the reasons are expected two or three billion increases in worldwide population, lowering the environmental impact of food production, and providing healthier alternatives for the human diet (Zeece, 2020). Urbanization has been accompanied by changes towards diets that have placed increased pressure on the environment and human health. Urban population growth has been associated with diets based on high consumption of meat, dairy, and processed foods, which contribute to environmental degradation and biodiversity loss and are responsible for around 30% of greenhouse gas (GHG) emissions (Cifuentes et al., 2021). In 2019 World resource institute have published working paper how shifting diets contribute to a sustainable future. Animal based foods are typically more resource-intensive and environmentally impactful to produce than plant-based foods. Shifting diet from beef towards less-impactful proteins is the most important policy goal for dietary sustainability in 2050. Fish can also help to shift to lower emission diets. Fish-eaters

have nearly same emissions profile as strict vegetarians. Vegan diet is the least impactful (Ranganathan et al., 2016). FAO and WHO (2019) also mention that dietary changes towards healthier diets can reduce the environmental impact of the food system, as evidence gathered so far show benefits of shifting towards more plant-based diet, including vegetables, fruits, nuts, pulses, and wholegrains. Due to environmental, ethical and health concerns it is increasingly popular to reduce the consumption of meat. For this reason, the focus on vegan, vegetarian and pescatarian diet in recent years has increased (Wozniak et al., 2020). What is more, life habits due to fast-paced life are changing. Consumers prefer minimum preparation meals, however, it is still important to consume high-quality, nutrient dense meals. Increase in vegan, vegetarian, and flexitarian populations have increased the usage of plant-based proteins (Ismail et al., 2020). Pulses, such as lentil, contain approximately twice the amount of protein as wholegrain cereals like oats, barley, wheat, and rice. About one third of the calories in lentil come from protein, making it the third-highest level of protein by weight of any legume or nut (Samaranayaka, 2017). Hokazono et al. (2009) in their study concluded that organic and sustainable rice production systems have the potential to mitigate global warming and eutrophication. The aim of this study was to develop quick preparation lentil and rice meals that would be suitable for a sustainable vegan and pescatarian diet and to analyse and compare their nutritional values.

MATERIALS AND METHODS

Quick preparation meal development tests were carried out at the laboratory of Felici LLC. As main ingredients dried lentils (*Lens culinaris*, L.) and rice (*Oryza sativa*, L.) were used. For vegan meal 64% of rice, 26% of green lentils and 10% different additional ingredients (dried carrot pieces, dried parsley, sea salt, dried garlic powder, dried onion pieces, turmeric, and yeast powder) to enrich the taste were used. For pescatarian meal 69% of rice, 20% of red lentil, 2.5% of freeze-dried salmon (*Salmo Salar* and *Oncorhynchus* spp) powder and 8.5% different additional ingredients (black sesame seeds, dried tomato pieces, sea salt, dried spinach flakes, ground ginger and yeast powder) to enrich the taste were used. At first different recipes quick meal samples were prepared, however, according to calculated nutritional value, sensory evaluation, and calculated price one vegan and one pescatarian meal were selected for further analysis. Both quick preparation meal samples can be seen in Fig. 1.

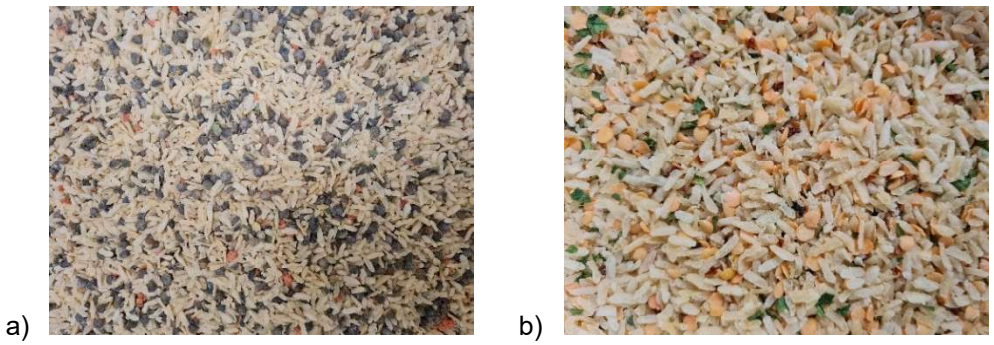

Figure 1. Vegan (a) and pescatarian (b) quick preparation meal samples.

Vegan and pescatarian quick preparation meal sample nutritional value, mineral and vitamin content were calculated according to Felici LLC raw material specifications. Calculations were made considering all ingredients used. Daily reference intake was calculated according to regulation (EU) No 1169/2011 of the European Parliament and the council of 25 October 2011. Nutritional claims were calculated according to regulation (EU) No 1924/2006 of the European Parliament.

RESULTS AND DISCUSSION

As mentioned in studies, depending on the variety, the composition of lentils is approximately 25–28% protein, 60–63% total carbohydrates of which 47% starch and around 1% fat (Faris et al., 2013; Zeece, 2020). According to used raw material specifications red lentils contain 25% protein, 51.7% carbohydrates of which 1.09% sugar, 2.1% fat and 11.4% dietary fibre. Green lentils contain 25.1% protein, 48.3% carbohydrates of which 0.79% sugar, 2.2% fat and 15.1% dietary fibre. A comparison of raw material specifications with literature shows that lentils contain similar protein content like written in other studies, however, they have lower carbohydrate and higher fat content. Depending on the variety, the composition of rice is approximately 6–7% protein, 74–80% carbohydrates of which 67–73% starch and 0.4–3% fat (Zeece, 2020; Carcea, 2021). According to used raw material specification rice contain 7.9% protein, 78.7% carbohydrates of which 0.3% sugar and 0.5% fat. A comparison of raw material specifications with literature shows that rice nutritional value is like data written in other studies. Due to salmon's nutritional profile, flavour, and availability it is one of the most popular fish for many consumers. The major component of fish is water which is a determinant of shelf life (Dawson et al., 2018). According to used raw material specification freeze-dried salmon contains 5% moisture, at least 50% protein and maximum 30% fat. From sustainability perspective freeze-drying is highly energy consuming (Karwacka et al., 2022), but from other hand these products are high quality, longer shelf-life, and less waste. Also, it is possible to decrease energy consumption during freeze-drying. Huang et al. (2009) and Rybak et al. (2021) in their study showed the possible ways to reduce it during freeze-drying process. Still, this practice should be implemented in daily production.

To check nutrient content in selected quick preparation meal samples, nutritional value was calculated according to raw material specifications. The Table 1 illustrates vegan and pescatarian quick meal sample nutritional values and percentage of dietary reference intakes (DRI) for energy, nutrients and iron, vitamin B1, B3 and B6. As it can be seen, both meal samples have similar energy value. As pescatarian meal sample contains sesame seeds and freeze-dried salmon powder, which contain around 30% of fat, it has three times higher fat content than vegan meal sample. Both quick preparation meals contain less than 3 grams of fat per 100 grams of product, they both are still low-fat meals. As mentioned before, lentils and rice have high carbohydrate content, 89 and 90% of rice and lentils mix was used, so prepared samples contain around 70 grams of carbohydrates per 100 grams of each meal sample. Data show that these meals are low sugar. Lower sugar and fibre content in pescatarian meal sample could be explained due to used lentil type and different additional ingredients used for taste enrichment. Meals contain more than 3 grams of fibre per 100 grams of product showing that quick preparation meals are source of fibre. Vegan and pescatarian meal have identical protein

content. Protein makes 14.7% of energy value in vegan meal and 14.1% of energy value in pescatarian meal showing that meals are source of protein.

Table 1. Vegan and pescatarian quick meal nutritional value

Nutritional value	Vegan meal		Pescatarian meal	
	Per 100 g	%, DRI	Per 100 g	%, DRI
Energy	1,502 kJ/354 kcal	17.7	1,566 kJ/370 kcal	18.5
Fat	0.8 g	1.1	2.7 g	3.9
of which saturates	0.1 g	0.5	0.5 g	2.5
Carbohydrates	71.0 g	27.3	72.0 g	27.7
of which sugars	2.1 g	2.3	1.3 g	1.4
Fibre	5.9 g	-	3.4 g	-
Protein	13.0 g	26.0	13.0 g	26.0
Salt	2.5 g	41.7	1.6 g	26.7
Iron	4.76 mg	34.0	4.40 mg	31.4
Vitamin B1 (Thiamin)	0.82 mg	74.5	1.00 mg	90.9
Vitamin B3 (Niacin)	5.40 mg	33.8	7.18 mg	44.9
Vitamin B6	0.72 mg	51.4	0.82 mg	58.6

To check additional nutrient content in quick preparation meal samples, vitamin and mineral content were calculated according to raw material specifications, amounts are recorded in Table 1. Both meals samples have significant amount of iron, what is an essential component for almost all biological systems. Humans require iron for energy production, oxygen transport and utilization, cellular proliferation, and pathogen destruction (Lynch et al., 2018). Iron deficiency is the only nutrient deficiency that is significantly widespread in developed and developing countries. This is the reason for the ongoing push for intensified iron fortification of staple diets (Blanco-Rojo & Vaquero, 2019). Lentils are great source of iron, it is present in significant quantity, however, it is known that due to phytochemicals its bioavailability is reduced (Faris & Attlee, 2017). B group vitamins have very important molecular function in human body, they are essential nutrients for adequate brain development, function, and protection (Bonetti et al., 2017). Both meals samples have significant vitamin B1, B3 and B6 content. Also, other studies have shown that lentils are significant dietary source of vitamin B1, B3 and B6 (Faris & Attlee, 2017; Ganesan & Xu, 2017). Different vitamin and mineral content in vegan and pescatarian meals samples are due to lentil types with different nutritional values. Vegan meal sample contains green lentils and pescatarian meal sample contains red lentils. According to EFSA food composition database dried salmon has high vitamin B1, B3, and B6 content. As it has a small percentage in meal it did not play important role in B vitamin content in pescatarian meal. Salmon is rich in vitamin B12, but as it is not base ingredient its content in pescatarian meal is still low and is not mentioned in this study. For more information, iron and B group vitamins bioavailability tests should be performed.

CONCLUSIONS

This study shows that using rice and lentil as base ingredients it is possible to develop nutritious vegan and pescatarian quick preparation meals according to EFSA nutrition claims. Data show that quick preparation meal samples are low fat, low sugar,

source of fibre and protein, and with high iron and vitamin B1, B2, B3 content. There is only small difference between vegan and pescatarian quick preparation meal sample nutritional values. The freeze-dried salmon powder had an impact on pescatarian meal sample fat content, it was three times higher than vegan meal sample fat content. Used lentil type has no significant impact on quick preparation meal sample nutritional values other than vitamin and minerals. Vegan quick preparation meal sample which contains green lentils has higher iron content. Pescatarian quick preparation meal which contains red lentils and freeze-dried salmon powder has higher vitamin B1, B3 and B6 content. Although both quick preparation meal samples have high iron, vitamin B1, B2 and B3 content there is no data for lentil and rice meal bioavailability. Further element bioavailability tests should be performed. Even though salmon is one of the most popular fish among consumers there are not many freeze-dried salmon producers and descriptive scientific data available.

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