



Comparing greenhouse gas emissions and nutritional value by using Korean meal plans for non-vegan and vegan



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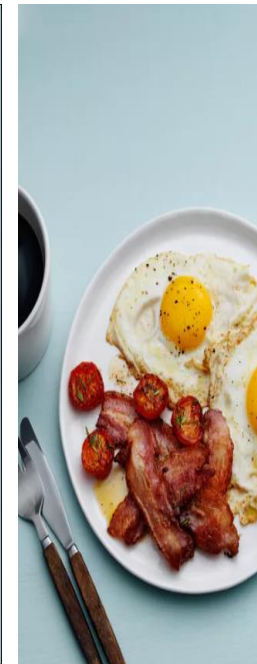
Index

- I. Objective
- II. Introduction
- III. Materials & methods
- IV. Results & discussions
- V. Conclusions
- VI. References



Objective

- Through comparing Korean suggested meal plans (SMP) with vegan meal plans (VMP), whether meal plan included meat or not, which meal plan is more healthier to the human nutrient and environment.



Introduction

- The production of animal-based foods is related to higher greenhouse gas (GHG) emissions than plant-based foods.
- Promoting changes in the western diet from meat eating toward more plant-based foods is option for mitigating climate change.
- To explore this trend which reduced or restricted the meat consumption is helpful to the climate change and human's health.



Materials & Methods

- The Korean suggested meal plans is from the Korean nutrition society and Comprehensive Food and Agriculture Information System, and vegan meal plans is changed from them, which has food's carbon-footprint data.
- The meal plans are made of considering the age 19 to 29, male, and nutrient values based on the calories by Dietary Reference Intakes for Koreans 2015.



Materials & Methods

Table 1. Suggested meal plans (SMP) and vegan meal plans (VMP) based on calories and total intake

| | VMP (g) | Total intake (g) / Total Calorie (kcal) | SMP (g) | Total intake (g) / Total Calorie (kcal) |
|---------------|---|--|--|--|
| Breakfast | Rice(210g) Potatoes sea weed soup(52g) Kimchi(40g) Seasoned spinach(86g) Braised black bean(20g) | 408g / 488.32kcal | Rice(210g) Beef sea weed soup(59g) Kimchi(40g) Seasoned spinach(86g) Grilled croaker(62g) | 457g / 520kcal |
| Lunch | Brown rice(210g) Kimchi stew(149g) Radish kimchi(50g) Seasoned mung bean sprout(38g) Radish water kimchi(250g) | 697g / 905.71kcal | Brown rice(210g) Enoki tofu doenjang soup(128g) Steamed egg(68g) Braised shishito pepper(111g) Seasoned bean sprout(78g) | 595g / 1032.5kcal |
| Dinner | Barley rice(210g) Korean wild chive doenjang jjigae(116g) Whole radish kimchi(35g) Perilla leave pickle(2g) Japchae with shiitake mushroom(81g) | 444g / 1023.37kcal | Barley rice(210g) Napa cabbage soup(100g) Spicy stir fried pork(157g) Lettuce fresh kimchi(91g) Seasoned eggplant(68g) | 626g / 1028.93kcal |
| Calorie(Kcal) | 2,417.4 | | 2,582.1 | |

Materials & Methods

- To calculate the GHG emissions from food, food's carbon footprint data, which is made by Life cycle assessment, from The Foundation of Agriculture Technology Commercialization and Transfer (FACT) was used.
- Food's carbon footprint data consists of 3 steps, production of inputs, transporting, and processing, cooking step.

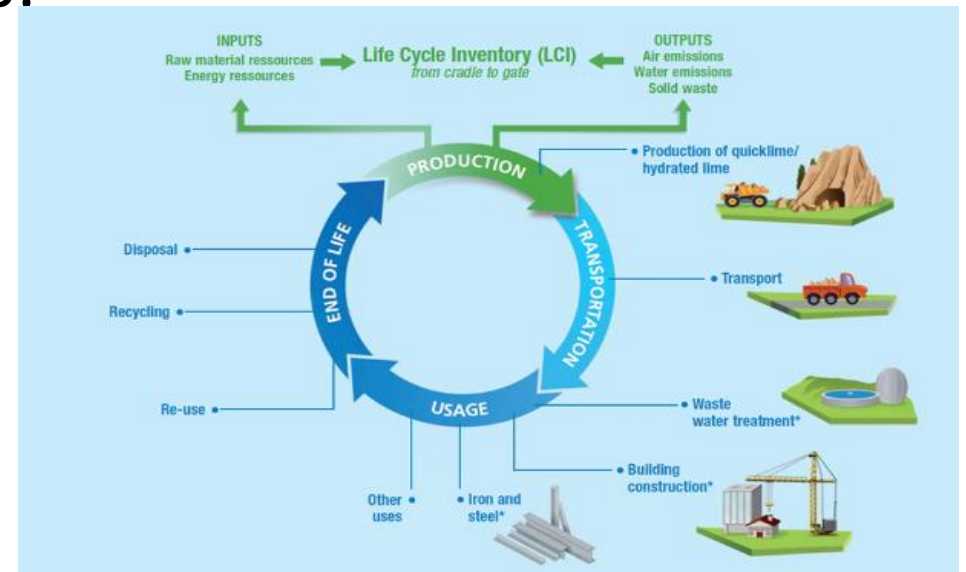


Table 2. Food's carbon footprint data

| | Name of food | GHG emissions (gCO ₂ e/1 portion) | | | | Reference |
|-------------|-----------------------------------|--|----------------|---------|-------|-------------------------|
| | | Producing | Transportation | Cooking | Total | |
| Rice | Rice | 53 | 5 | 57 | 115 | FACT |
| | Brown rice | 60 | 6 | 94 | 160 | FACT |
| | Barley rice | 50 | 5 | 65 | 120 | FACT |
| Sidedish | Kimchi | 70 | 6 | 0 | 76 | FACT |
| | Seasoned spanich | 60 | 5 | 71 | 136 | FACT |
| | Braised black bean | 67 | 3 | 100 | 170 | FACT |
| | Grilled croaker | 30 | 10 | 50 | 90 | Ministry of environment |
| | Steamed egg | 134 | 3 | 51 | 188 | FACT |
| | Braised shishito pepper | 206 | 10 | 10 | 226 | Ministry of environment |
| | Radish water kimchi | 22 | 2 | 3 | 27 | FACT |
| | Seasoned bean sprout | 29 | 2 | 30 | 61 | FACT |
| | Seasoned mung bean | 59 | 5 | 35 | 99 | FACT |
| | Radish kimchi | 64 | 4 | 0 | 68 | FACT |
| | Whole radish kimchi | 50 | 4 | 2 | 56 | FACT |
| | Perilla leave pickle | 40 | 1 | 30 | 71 | FACT |
| | Japchae with shiitake mushroom | 447 | 5 | 106 | 558 | FACT |
| | Spicy stir fried pork | 432 | 7 | 21 | 460 | FACT |
| | Lettuce fresh kimchi | 110 | 0 | 0 | 110 | Ministry of environment |
| | Seasoned eggplant | 447 | 5 | 13 | 465 | Ministry of environment |
| Broth, stew | Potatoes sea weed soup | 40 | 2 | 93 | 135 | Ministry of environment |
| | Beef sea weed soup | 568 | 2 | 93 | 663 | FACT |
| | Kimchi stew | 383 | 10 | 94 | 487 | FACT |
| | Enoki tofu doenjang soup | 170 | 5 | 142 | 317 | Both |
| | Korean wild chive doenjang jjigae | 271 | 6 | 94 | 371 | FACT |
| | Napa cabbage soup | 114 | 5 | 142 | 261 | Both |

Materials & Methods

- All nutrient values is from 9th revision Korean Food Composition Table I and II, which included macronutrients and micronutrients.

Table 3. Suggested meal plans (SMP) and vegan meal plans (VMP), macronutrient values

| Nutrient components | Total calorie (Kcal) | | Carbo (g) | | Protein (g) | | Fat (g) | |
|---------------------|----------------------|----------|-----------|--------|-------------|--------|---------|-------|
| | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP |
| Breakfast | 488.32 | 520.62 | 92.02 | 83.47 | 18.67 | 32.30 | 8.20 | 8.24 |
| Lunch | 905.71 | 1,032.5 | 179.35 | 197.47 | 22.15 | 35.38 | 10.44 | 17.64 |
| Dinner | 1,023.37 | 1,028.93 | 228.07 | 197.81 | 23.45 | 35.00 | 5.05 | 9.00 |
| Total | 2,417.4 | 2,582.05 | 499.44 | 478.75 | 64.27 | 102.69 | 23.69 | 34.87 |

Table 4. Suggested meal plans (SMP) and vegan meal plans (VMP), micronutrient values

| Nutrient components | Ca (mg) | | Fe (mg) | | Mg (mg) | | P (mg) | | K (mg) | | Na (mg) | | Folic acid (µg) | | VitaminB12 (µg) | |
|---------------------|---------|--------|---------|-------|---------|--------|----------|----------|----------|----------|----------|----------|-----------------|--------|-----------------|------|
| | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP |
| Breakfast | 269.94 | 258.64 | 5.96 | 5.63 | 102.53 | 100.30 | 283.66 | 354.25 | 1,872.88 | 1,880.48 | 2,061.10 | 2,607.36 | 287.14 | 203.50 | 0.00 | 3.26 |
| Lunch | 160.60 | 242.19 | 4.35 | 6.61 | 97.04 | 111.81 | 361.64 | 608.08 | 1,223.65 | 1,512.19 | 2,449.70 | 3,138.14 | 63.46 | 199.60 | 0.00 | 1.00 |
| Dinner | 143.03 | 155.23 | 8.53 | 5.72 | 87.93 | 83.43 | 395.08 | 490.98 | 1,459.15 | 1,351.24 | 1,535.26 | 2,004.15 | 202.83 | 63.01 | 0.00 | 0.23 |
| Total | 573.57 | 656.06 | 18.84 | 17.96 | 287.50 | 295.54 | 1,040.38 | 1,453.31 | 4,555.68 | 4,743.91 | 6,046.06 | 7,749.65 | 553.43 | 466.11 | 0.00 | 4.48 |

Materials & Methods

Table 5. Suggested meal plans (SMP) and vegan meal plans (VMP), amino acid values

| Nutrient components | Total amino acid (mg) | | Essential amino acid (mg) | | Non essential amino acid (mg) | |
|---------------------|-----------------------|-----------|---------------------------|-----------|-------------------------------|-----------|
| | VMP | SMP | VMP | SMP | VMP | SMP |
| Breakfast | 18,094.40 | 31,496.94 | 7,971.83 | 14,360.96 | 10,122.57 | 17,135.98 |
| Lunch | 6,541.28 | 18,864.72 | 2,850.16 | 8,764.81 | 3,691.12 | 10,099.91 |
| Dinner | 8,123.43 | 19,329.72 | 3,537.54 | 9,167.93 | 4,585.89 | 10,168.94 |
| Total | 32,759.11 | 69,691.38 | 14,359.53 | 32,293.70 | 18,399.58 | 37,404.83 |

Table 6. Suggested meal plans (SMP) and vegan meal plans (VMP), fatty acids values

| Nutrient components | Total fatty acid (g) | | Total essential fatty acid (g) | | Total saturated fatty acid (g) | | Total single unsaturated fatty acid (g) | | Total poly unsaturated fatty acid (g) | |
|---------------------|----------------------|-------|--------------------------------|-------|--------------------------------|------|---|------|---------------------------------------|-------|
| | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP | VMP | SMP |
| Breakfast | 9.54 | 9.48 | 5.05 | 3.21 | 1.69 | 2.37 | 2.78 | 3.23 | 5.05 | 3.81 |
| Lunch | 4.44 | 10.84 | 2.44 | 4.23 | 0.71 | 2.68 | 1.27 | 3.81 | 2.45 | 4.32 |
| Dinner | 3.72 | 7.18 | 1.91 | 2.72 | 0.76 | 1.74 | 1.04 | 2.67 | 1.91 | 2.74 |
| Total | 17.69 | 27.50 | 9.40 | 10.15 | 3.16 | 6.79 | 5.09 | 9.70 | 9.41 | 10.87 |

Results & discussions

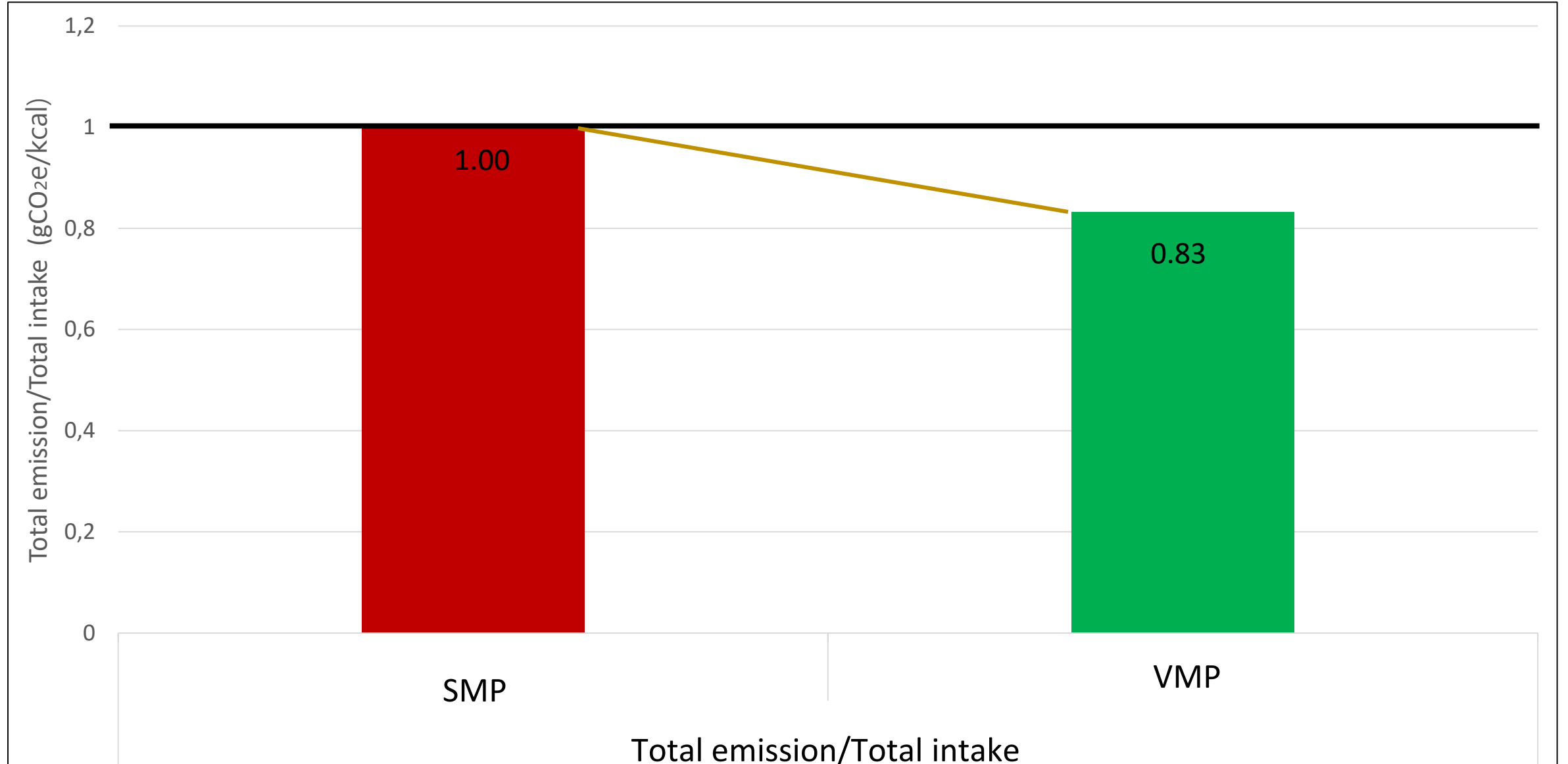


Fig 1. Comparing GHG emissions suggested meal plans (SMP) and vegan meal plans (VMP)

Results & discussions

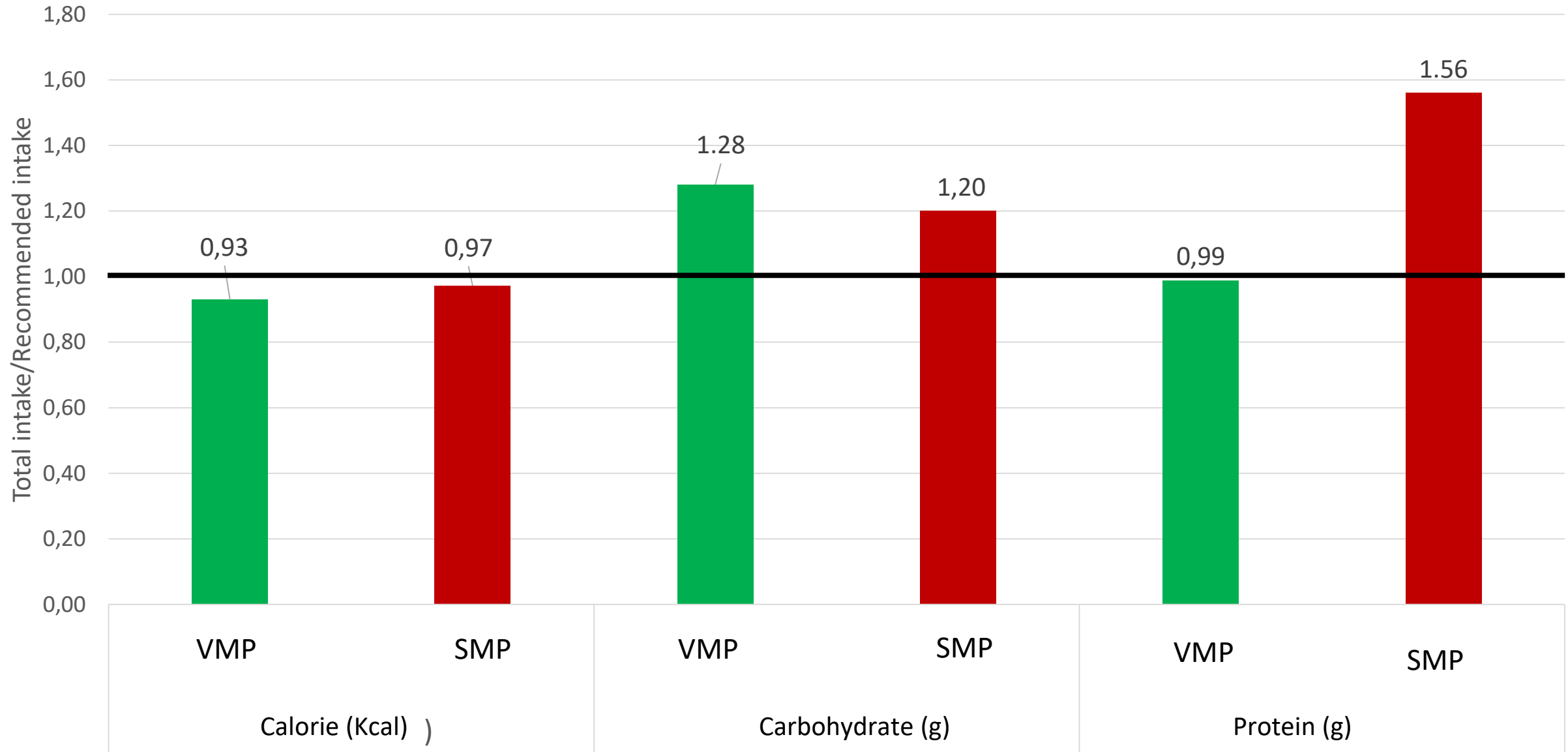


Fig 2. Comparing calorie, carbohydrate, protein between suggested meal plans (SMP) and vegan meal plans (VMP)

Results & discussions

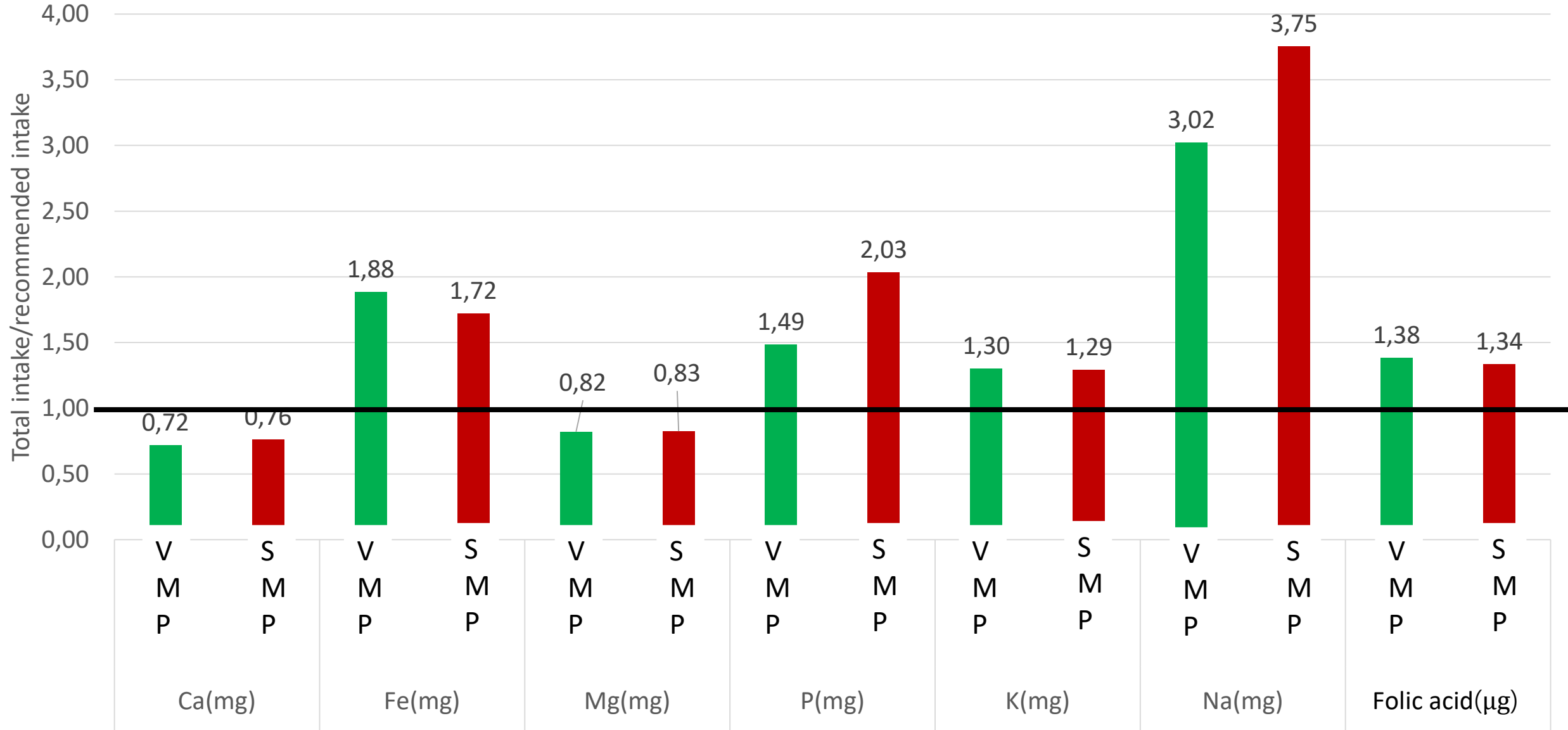


Fig 3. Comparing micro nutrient(Ca, Fe, Mg, P, K, Na, Folic acid) between suggested meal plans (SMP) and vegan meal plans (VMP)

Results & discussions

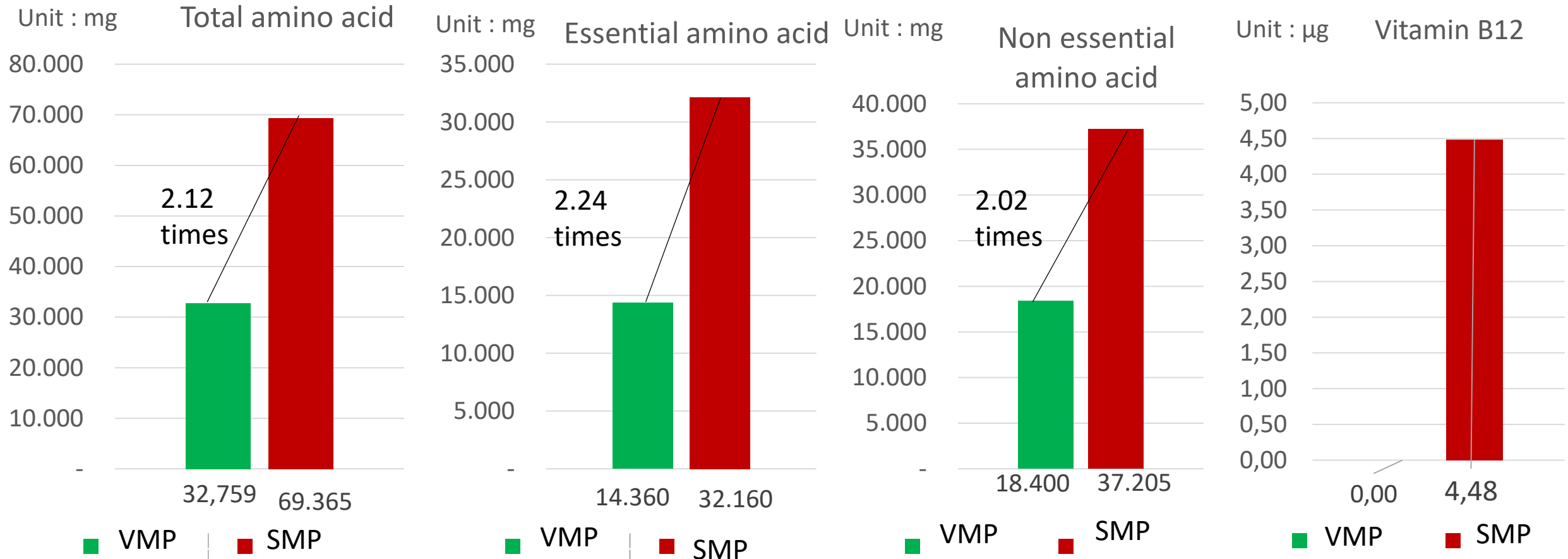


Fig 4. Comparing amino acid amount and vitamin B12 between suggested meal plans (SMP) and vegan meal plans (VMP)

Results & discussions

- The GHG emissions(Total emission/Total intake) of VMP is 17% lower than SMP.
- Protein was 1% not sufficient in VMP, but SMP was 56% higher than recommended intake.
- Ca and Mg is not enough for both meal plan, but the others fulfill the recommended intake.
- In total amino acid, essential amino acid, and non essential amino acid, VMP is 2.12, 2.24, and 2.02 times lower than SMP.
- About vitamin B12, VMP was 0 μg , but SMP was 4.48 μg .

Conclusions

- In meal plan based on energy (Kcal), CO₂ emissions in SMP were higher than VMP, but comparing protein intake divided by CO₂ emissions (mg/ gCO₂e) should be conducted in the near future.
- In amino acid, it can occur some amino acid deficiency. The more research about amino acid deficiency should be conducted.
- Vitamin B12 deficiency can occur, if people keep eating VMP, that they have to eat some vitamin supplement which needs also LCA (Life cycle assessment).
- The more research about LCA data is needed for Korean food and ingredients.

References

- 1) Annika Carlsson-Kanyama, (1998) Climate change and dietary choices – how can emissions of greenhouse gases from food consumption be reduced?
- 2) Petr Havlik, et al. (2014) Climate change mitigation through livestock system transitions
- 3) Joop de Boer, et al. (2013) Climate change and meat eating: An inconvenient couple?
- 4) Charlotte LR Payne, et al. (2016) Do low-carbon-emission diets lead to higher nutritional quality and positive health outcomes? A systematic review of the literature
- 5) Peter Scarborough, et al. (2014) Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK
- 6) Korea Nutrition Society, (2015) Dietary Reference Intakes for Koreans 2015
- 7) Foundation of Agriculture Technology Commercialization and Transfer (FACT), 2012 Building the food's carbon footprint database
- 8) Korea national agriculture sciences (2017), 9th revision Korean Food Composition Table I and II
- 9) Claire T McEvoy, et al. (2011) Vegetarian diets, low-meat diets and health : a review
- 10) Seul E.H, et al. (2016) The Health Co-benefits of Changing Dietary Greenhouse Gas Emissions (GHGe) through Dietary Scenarios in Korea
- 11) Korea Ministry of environment (2010), Food's energy consuming amount and greenhouse gas emissions (GHGE) evaluation and calculation.

For better environment for our life and the earth

Thank you

Q&A

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