

Replacing animal meat with plant-based meat: a modelling study on the impact on total diet protein adequacy

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BACKGROUND

The quality of plant proteins is generally inferior to the quality of animal proteins, therefore people on a plant-forward diet question if they get sufficient high-quality protein to fulfil protein requirements. Insights are needed on how replacing animal meat with plant-based meat from different protein sources impacts protein adequacy.

AIM

To model the impact of replacing animal meat with plant-based meat alternatives (PBM) on total diet protein adequacy, in the context of a typical Dutch diet.

METHODS

Protein adequacy

Protein adequacy was evaluated as the ratio between utilisable protein per meal per day and protein Estimated Average Requirement for Dutch adults (0.66g/kg body weight (BW))^{1,2}.

Data sources

- Data from 2147 adults from the Dutch national food consumption survey (VCP) from 2012-16³.
- For each food product in the VCP, data on amino acid composition and protein digestibility were included¹.
- Digestibility⁵, amino acid profile⁶ and amino acid score (AAS) of baseline and selected products are shown in **Figure 1**, and protein content is shown in **Table 1**.

Modelling approach

- Realistic scenario: replacing animal meat with currently available PBM (from online supermarket data⁴).
- Explorative scenarios: replacing animal meat with PBM from selected protein sources at specific protein contents.
- Assumptions: 100% replacement; gram-for-gram replacement; other dietary choices remain unchanged.

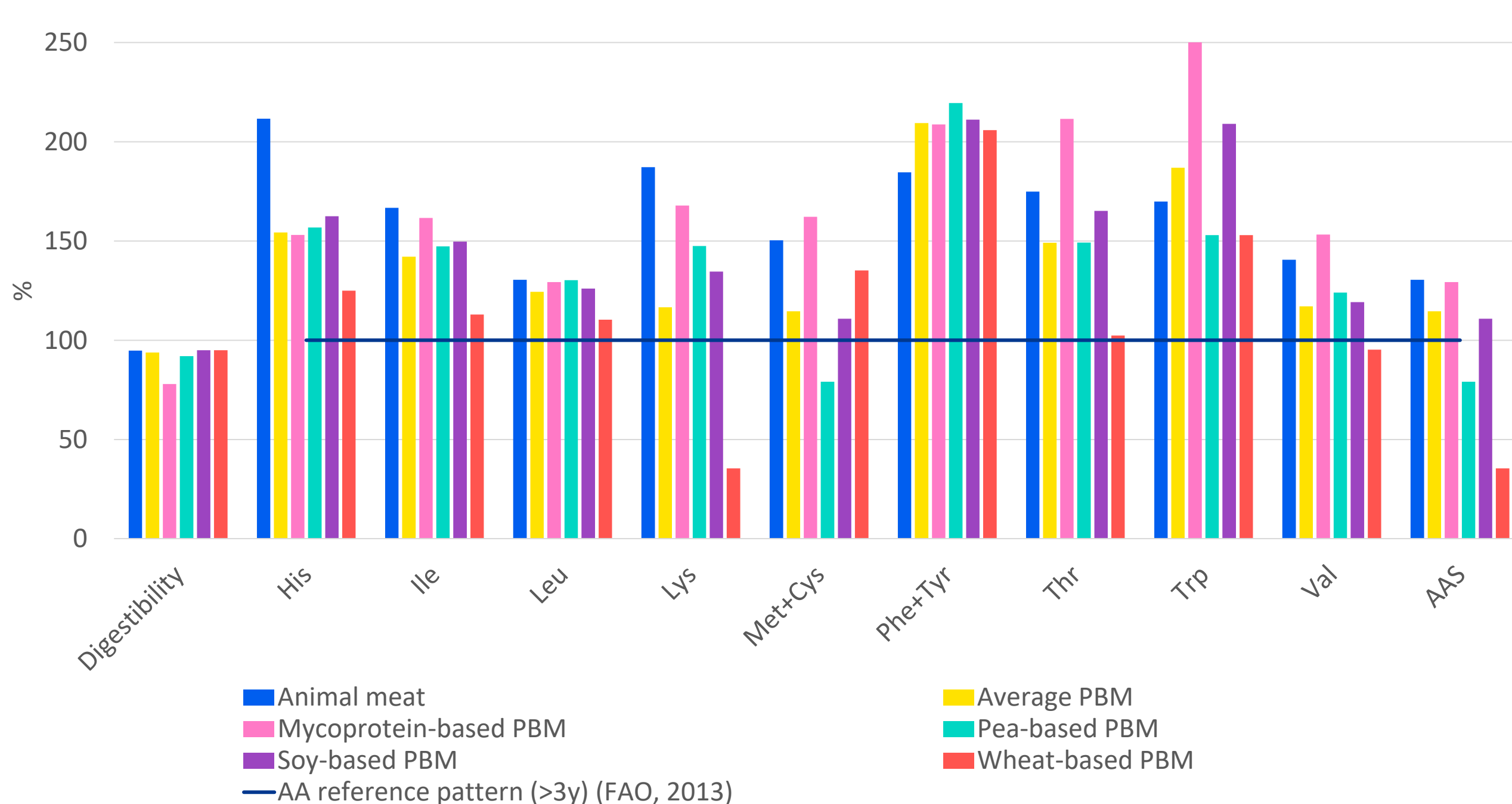


Figure 1. Protein digestibility (%), amino acid profile (%) and amino acid score (%) relative to amino acid reference pattern >3y (FAO, 2013) of the **selected products**. AAS = Amino Acid Score; PBM = Plant-based meat

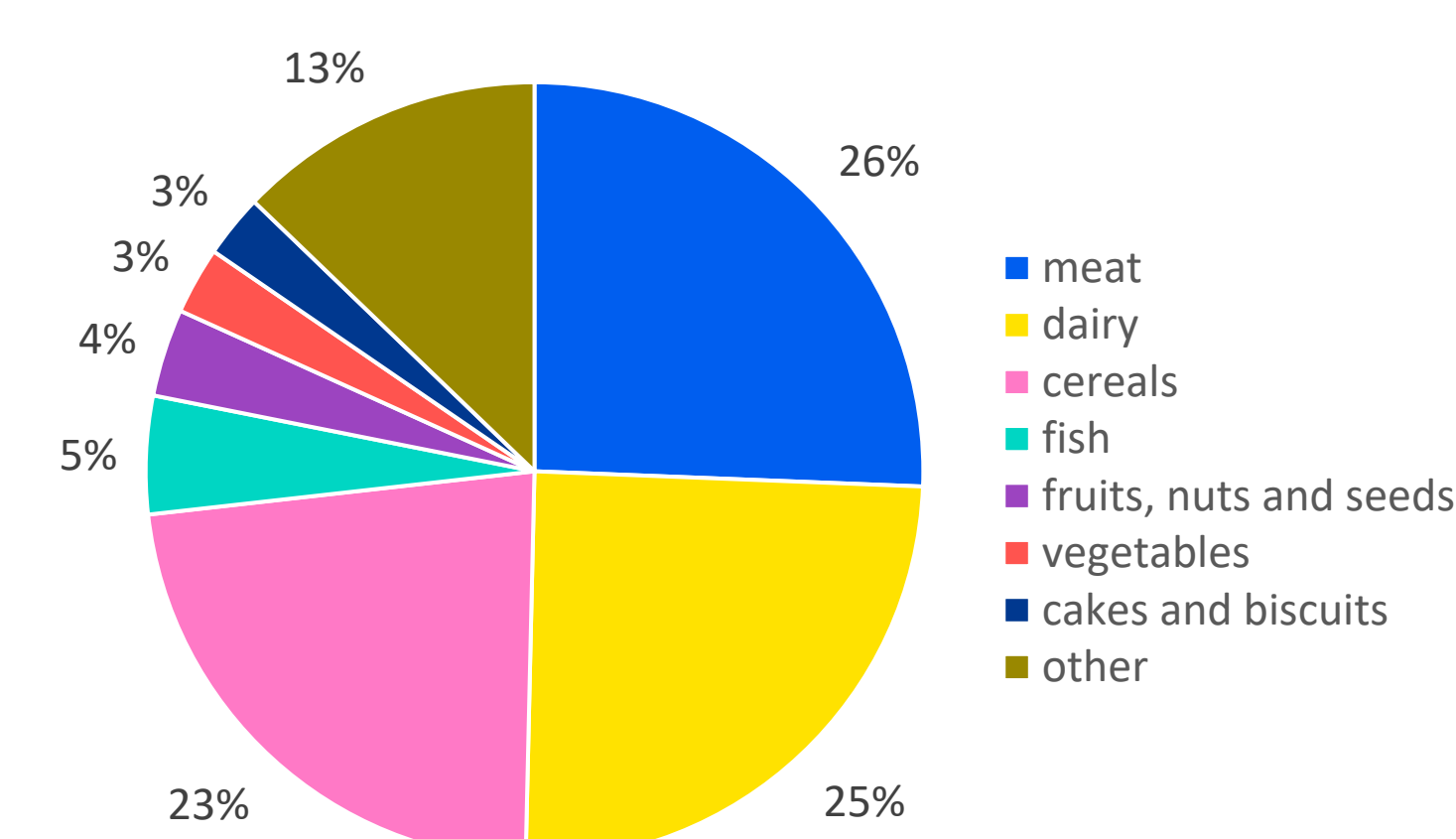


Figure 2. Protein intake by food group in the baseline diet

Selected products	Total protein (g/100g)
Animal meat	19
Average PBM	15.4
Mycoprotein 10%	10
Pea 10%	10
Soy 10%	10
Wheat 10%	10
Mycoprotein 25%	25
Pea 25%	25
Soy 25%	25
Wheat 25%	25

Table 1. Total protein content of the selected products

RESULTS

Realistic scenario

- Replacing animal meat with average PBM lowered the contribution of animal-based foods to total protein intake from 59 to 36% (**Figure 2**).
- Replacing animal meat with average PBM resulted in:
 - Lower protein adequacy from 87 to 83% (**Figure 3**).
 - Lower total protein intake from 0.98 to 0.93 g/kg BW.
 - Lower diet digestibility from 88.5 to 88.0% (**Figure 4**).
 - Complete diet amino acid profile (AAS>100) (**Figure 4**).

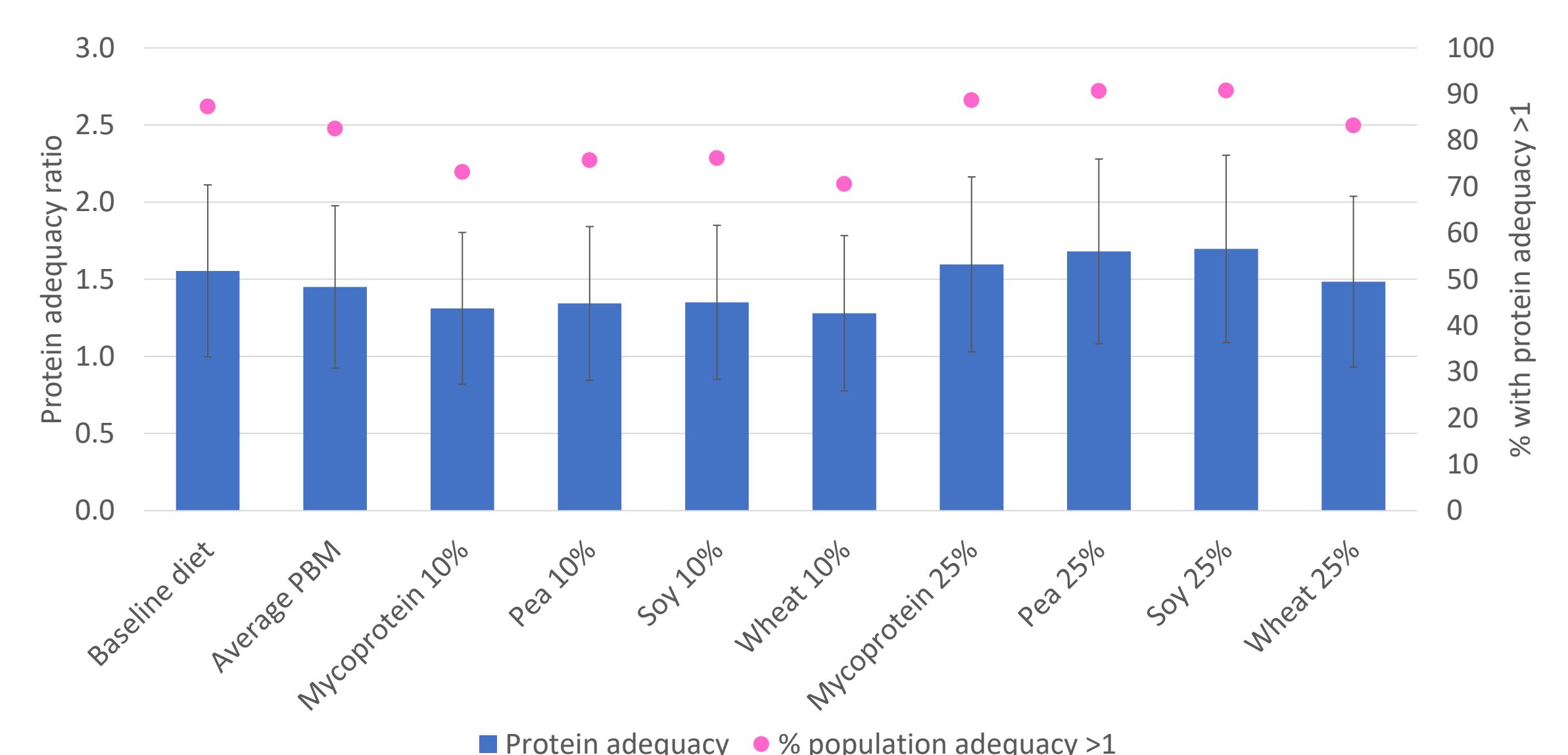


Figure 3. Mean protein adequacy ratio and percentage of people with adequate protein intake before and after replacements in realistic and explorative scenarios

Explorative scenarios

- Replacing animal meat with PBM 10% from selected protein sources lowered total diet protein adequacy from 83% to 71-76% (**Figure 3**).
- Replacing animal meat with PBM 25% from selected protein sources resulted in higher protein adequacy from 83% to 87-91%, except for the diet with wheat-based PBM (83%) (**Figure 3**).
- In the diet with wheat-based PBM lysine was the limiting amino acid.

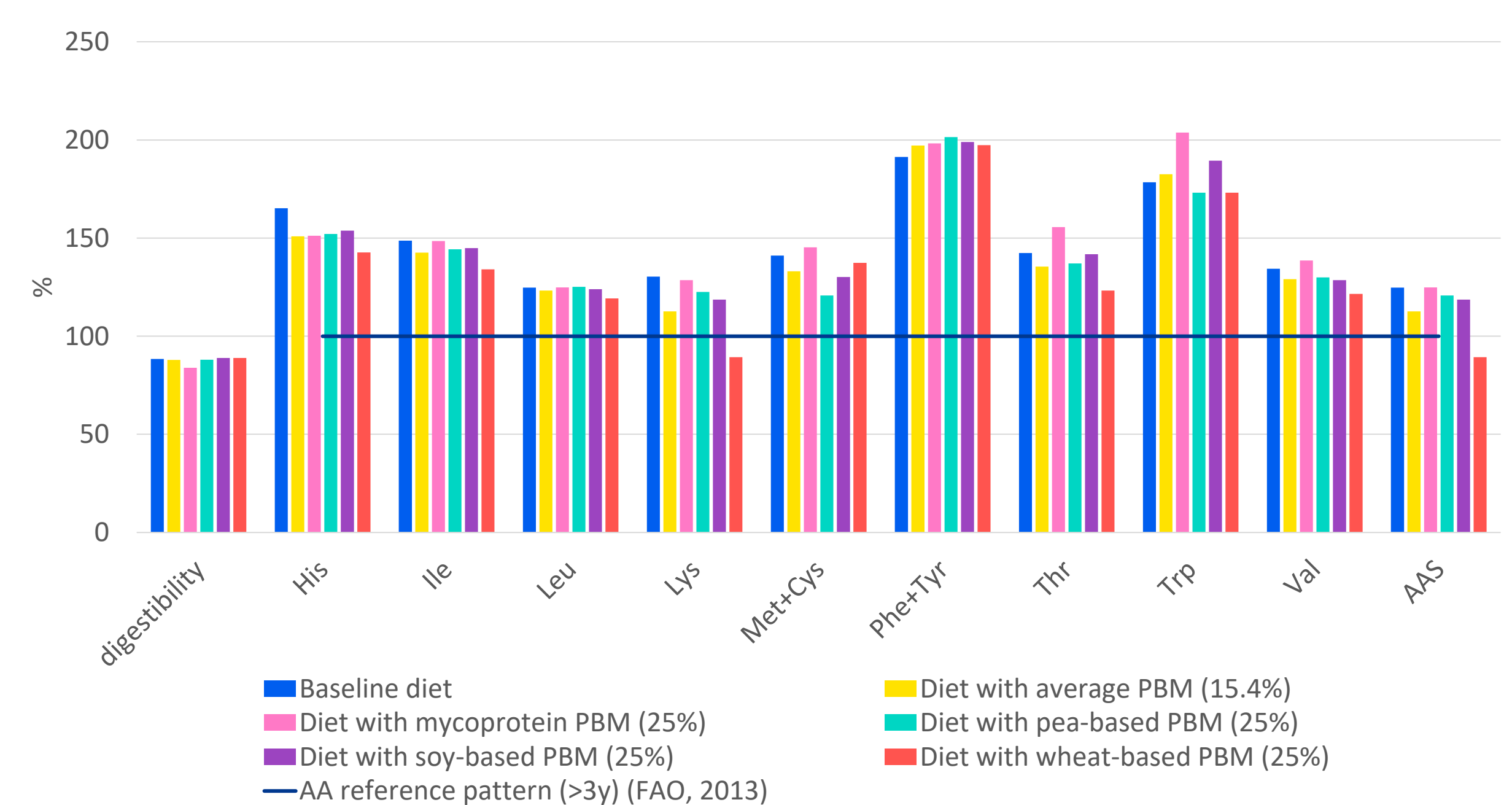


Figure 4. Mean protein digestibility (%), amino acid profile (%) and amino acid score (%) relative to amino acid reference pattern >3y (FAO, 2013) of the **total diets** before and after replacements in realistic and explorative scenarios. AAS = Amino Acid Score; PBM = Plant-based meat

CONCLUSION

This research indicated that in an extreme scenario when all animal meat is replaced with currently available plant-based meat, utilisable protein intake will slightly decrease but will remain adequate.

In this study, factors impacting protein adequacy were total protein and lysine content, but to a lesser extent protein source, protein digestibility and amino acid score.

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