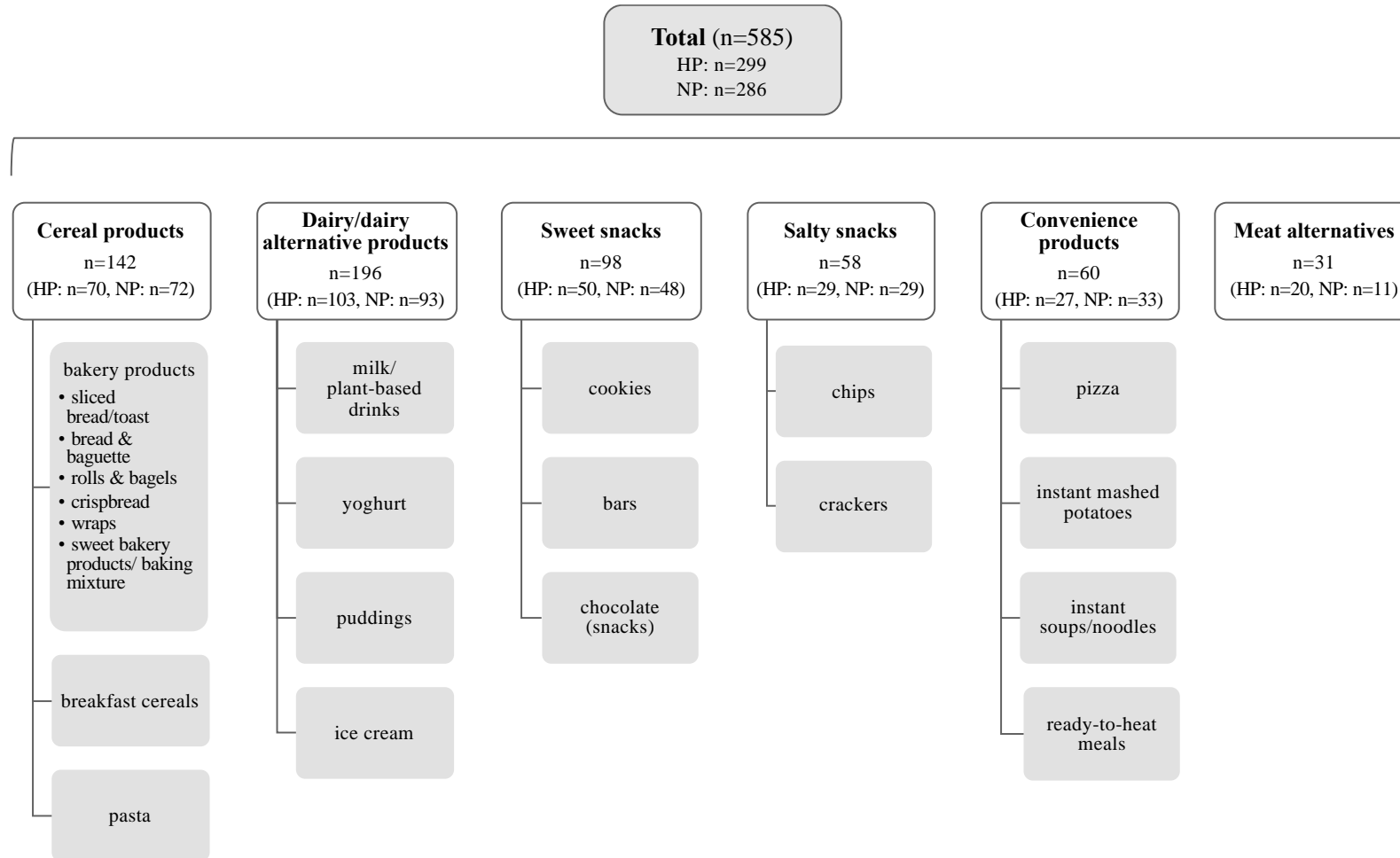
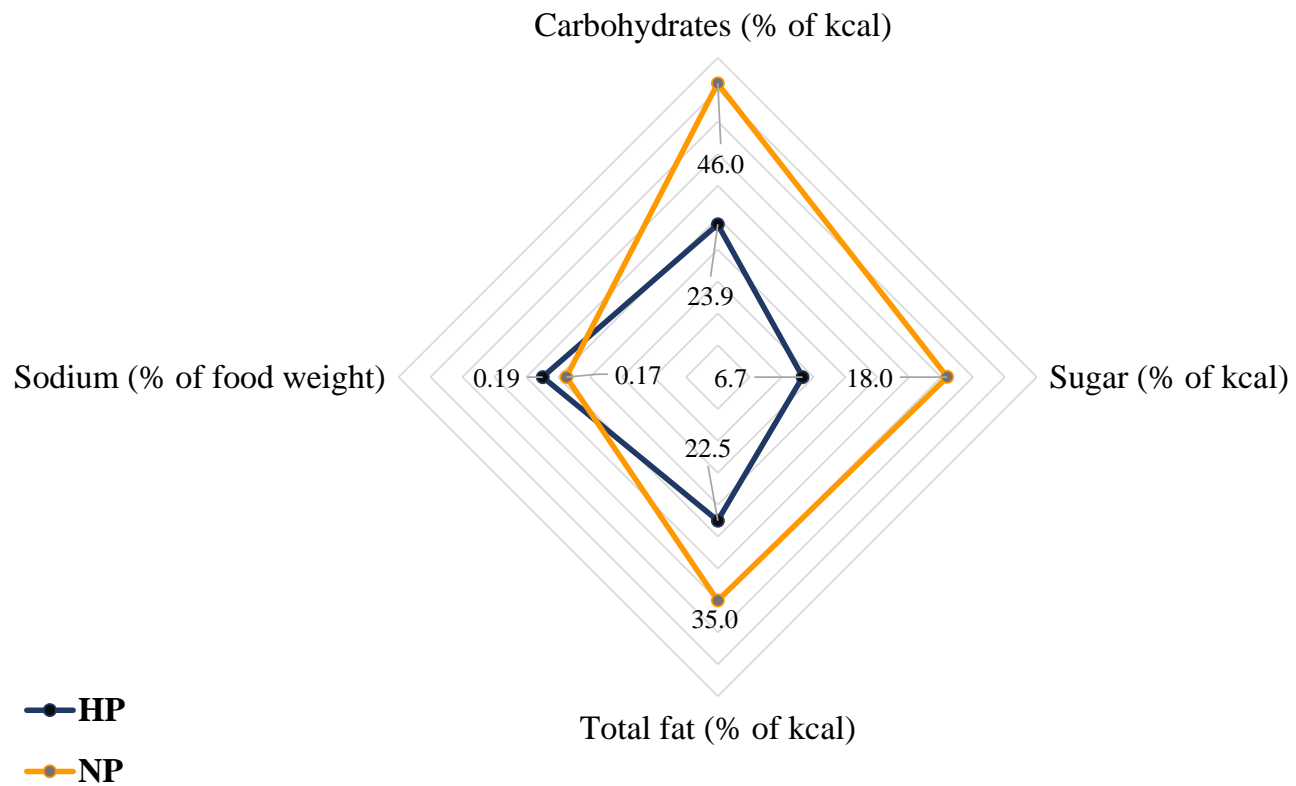


Nutritional value and environmental aspects of high-protein ultra-processed foods on the German market

Supplementary material



Supplemental Figure 1. Stratification of HP (high-protein) and NP (normal-protein) ultra-processed foods in six food categories



Supplemental Figure 2. Spider Web Plot showing the relevant nutrients for defining hyper-palatable foods according to Fazzino et al. (2019)⁽²⁴⁾ in high-protein (HP, n=299) vs. normal-protein (NP, n=286) ultra-processed foods, fibre content was not subtracted from % of kcal from carbohydrates. Data presented as median.

Supplemental Table 1. Protein fortification sources in high-protein ultra-processed food.

Protein source	All Products	Non-dairy products
	n=299 %	n=196 %
Animal-derived†	62.2	43.3
milk	60.2	41.8
collagen (hydrolysate)	6.4	8.7
chicken egg	3.7	4.6
Plant-derived†	54.8	82.6
soya	24.7	36.7
wheat	24.1	36.7
pea	17.7	27.0
rice	5.4	8.2
sunflower	3.7	5.6
oat	1.7	2.6
potatoe	1.3	2.0
lupine	1.3	2.0
corn	1.0	1.5
buckwheat	1.0	1.0
rapeseed	0.7	1.0
pumpkin seed	0.7	1.0
Combination of plant and animal protein	17	26.0
milk/soya	8.4	12.8
wheat/pea	4.3	6.6
milk/collagen (hydrolysate)	3.7	4.6
soya/wheat	3.0	4.6
milk/wheat	2.3	3.6
milk/collagen(hydrolysate)/soya	2.0	3.1
pea/rice/sunflower	2.0	3.1
milk/pea/wheat	1.3	2.0
milk/chicken egg/wheat	1.0	1.5
chicken egg/soya/wheat	1.0	1.5
pea/rice/wheat	1.0	1.5
pea/rice/buckwheat	1.0	0.0
pea/rice	0.7	1.0
wheat/lupine	0.7	1.0
milk/chicken egg/collagen(hydrolysate)	0.7	1.0

†combinations of protein sources possible.

Supplemental Table 2. Comparison of price of high-protein and normal-protein ultra-processed food in total and stratified in six food categories.

	Group	<i>n</i>	Price	
			€/100 g median	IQR
Total		585		
	HP	299	1.9	0.8-3.6
	NP	286	0.8***	0.4-1.5
Cereal products		142		
	HP	70	1.7	1.3-2.5
	NP	72	0.6***	0.4-0.9
Dairy/dairy alternative products		196		
	HP	103	0.6	0.5-0.9
	NP	93	0.5***	0.3-0.6
Sweet snacks		98		
	HP	50	4.1	3.3-4.9
	NP	48	1.5***	1.2-2.1
Salty snacks		58		
	HP	29	4.8	3.9-6.0
	NP	29	1.5***	1.3-2.0
Convenience products		60		
	HP	27	3.6	2.0-3.7
	NP	33	1.0***	0.6-1.8
Meat alternatives		31		
	HP	20	1.7	1.6-2.1
	NP	11	1.8	1.2-2.2

IQR, interquartile range. HP, high-protein. NP, normal-protein. * $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$ as assessed by Mann-Whitney-U-Test, p-values refer to differences between HP and NP products and are further indicated in bold.