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26 – 28 SEPTEMBER 2023

Innovative food products

Consumers' perception of alternative proteins: risk-benefit considerations

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Content

Three case studies

- Consumer willingness to adopt **insects** and its determinants
- Barriers vs. motives shaping consumers' willingness to eat **cultured meat**
- Consumer perception and interest in **foods with microalgae proteins**

Conclusions

1. Consumer willingness to adopt **insects** and its determinants

Source: Verbeke (2015) Food Quality and Prefererence **39**

Survey, sample

- Data collection December 2013
- n = 404, incl. 368 meat consumers
- 39% men; 61% women
- Age 18-79 years; average age 42 years
- Representative for region across five provinces of Flanders (BE)
- 24% with daily meat consumption; 67% several-times-a-week
- 17% planned to reduce meat consumption
- 72% had “ever heard” about the eating of insects

Source: Verbeke (2015) Food Qual Prefer **39**

Willingness-to-adopt insects

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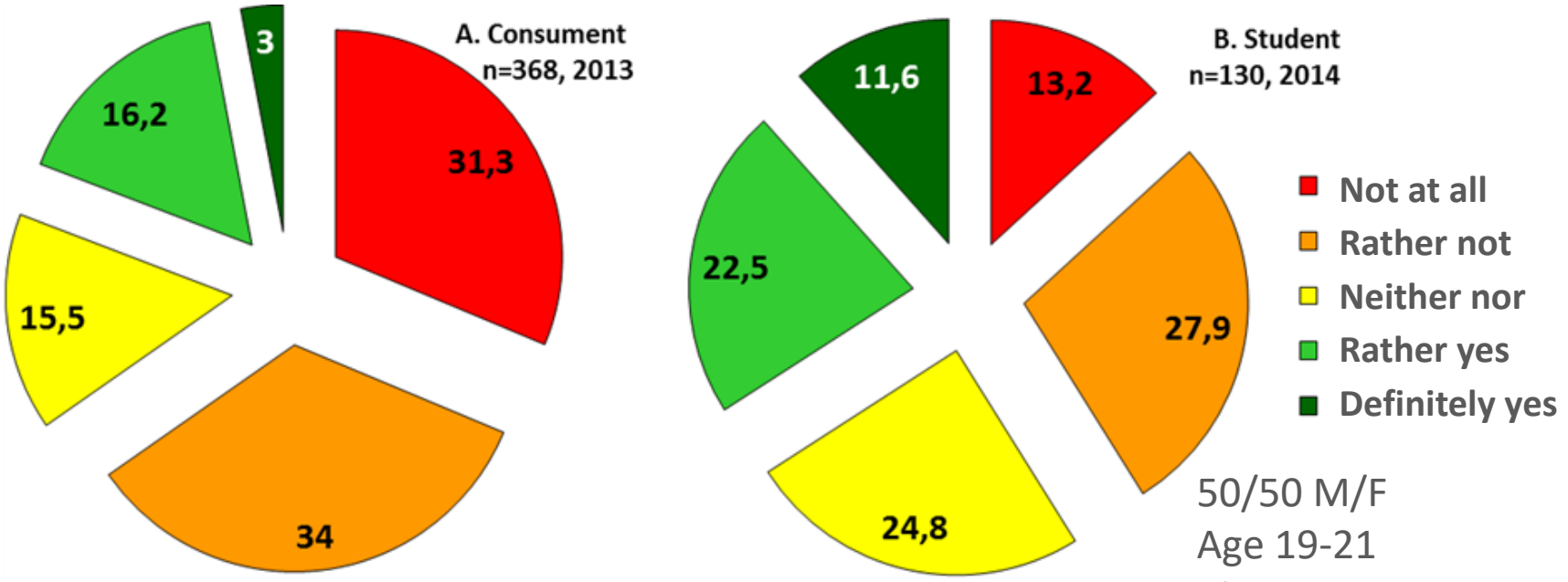
Representative sample of consumers vs. Convenience sample of students



50/50 M/F
Age 19-21
Classroom setting
B.Sc. Bio-Science Engineering

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Statistical modeling
(%; n=368; 2013; Flanders, Belgium)

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$$\begin{cases} y_i = 1 & if\ z_i > 0 \\ y_i = 0 & if\ z_i \leqslant 0 \end{cases}$$

Willingness to adopt (WTA) insects is modeled as a probability that is determined by personal characteristics, attitudinal and behavioural variables using binary logistic regression.

$$p_i = \text{prob}\,(y_i = 1) = \frac{e^{z_i}}{1 + e^{z_i}} = \frac{e^{\beta 0 + \sum_{k=1}^{K} \beta_k x_{ki}}}{1 + e^{\beta 0 + \sum_{k=1} K \beta_k x_{ki}}} \text{ or}$$

$$\log\left(\frac{pi}{1 - pi}\right) = z_i = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i$$

$$= \beta_0 + \beta_1\,\text{Male}_i + \beta_2\,\text{Age}_i + \beta_3\,\text{Edu}_i + \beta_4\,\text{Fam}_i + \beta_5\,\text{FNS}_i + \beta_6\,\text{FTNS}_i + \beta_7\,\text{FHealth}_i + \beta_8\,\text{FConc}_i + \beta_9\,\text{FEnv}_i + \beta_{10}\,\text{MTate}_i + \beta_{11}\,\text{MNutr}_i + \beta_{12}\,\text{MRed}_i + \varepsilon_i$$

Logistic regression coefficients and odds ratios indicate the impact of a variable on WTA. Coefficient estimates can be used to calculate probabilities for different profiles of consumers.

Source: Verbeke (2015) Food Qual Prefer **39**

Results
(n=368; 2013; Flanders, Belgium)

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Table 3
Coefficient estimates and diagnostics from binary logistic regression explaining consumers' readiness to adopt insects as a substitute for meat (n = 368).

Variable	β	S.E.	Wald	Sig.	Exp (β)	
Gender (male)	0.774	0.363	4.553	0.033	2.169	
Age	−0.028	0.012	5.256	0.022	0.973	
Education	0.005	0.421	0.000	0.991	1.005	
Fam	0.957	0.447	4.580	0.032	2.604	Familiarity
FNS	−1.811	0.361	25.125	<0.001	0.164	Food neophobia
FTNS	−0.788	0.252	9.741	0.002	0.455	Food technology neophobia
FHealth	0.416	0.239	3.014	0.083	1.515	Interest in health
FConv	0.557	0.197	7.973	0.005	1.746	Interest in convenience
FEnv	0.539	0.198	7.430	0.006	1.714	Interest in the environment
MTaste	−0.952	0.293	10.580	0.001	0.386	Attachment to meat taste
MNutr	−1.025	0.264	15.024	<0.001	0.359	Belief meat is nutrition
MRed	1.507	0.389	15.022	0.001	4.512	Intention to reduce meat
Constant	7.999	2.362	11.466	<0.001		

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Interpretation

The likelihood of adopting insects as an alternative to meat …

- Is **double** as large among **men** compared to women
- Decreases with **27% per 10 years** age increase
- Is **4.5** times bigger among people who plan to **reduce meat intake**
- Is **2.6** times bigger among people **who have heard about it**
- Increases with **75%** per unit importance attached to **convenience**
- … with **71%** per unit importance attached to **environmental impact**
- Decreases with **84%** per unit on the scale of **food neophobia**
- … with **55%** per unit on the scale of **food technology neophobia**
- … with **61-64%** per unit importance attached to the taste of meat and conviction that meat is nutritious and healthy

Source: Verbeke (2015) Food Qual Prefer **39**

Simulated probability of willingness to adopt insects

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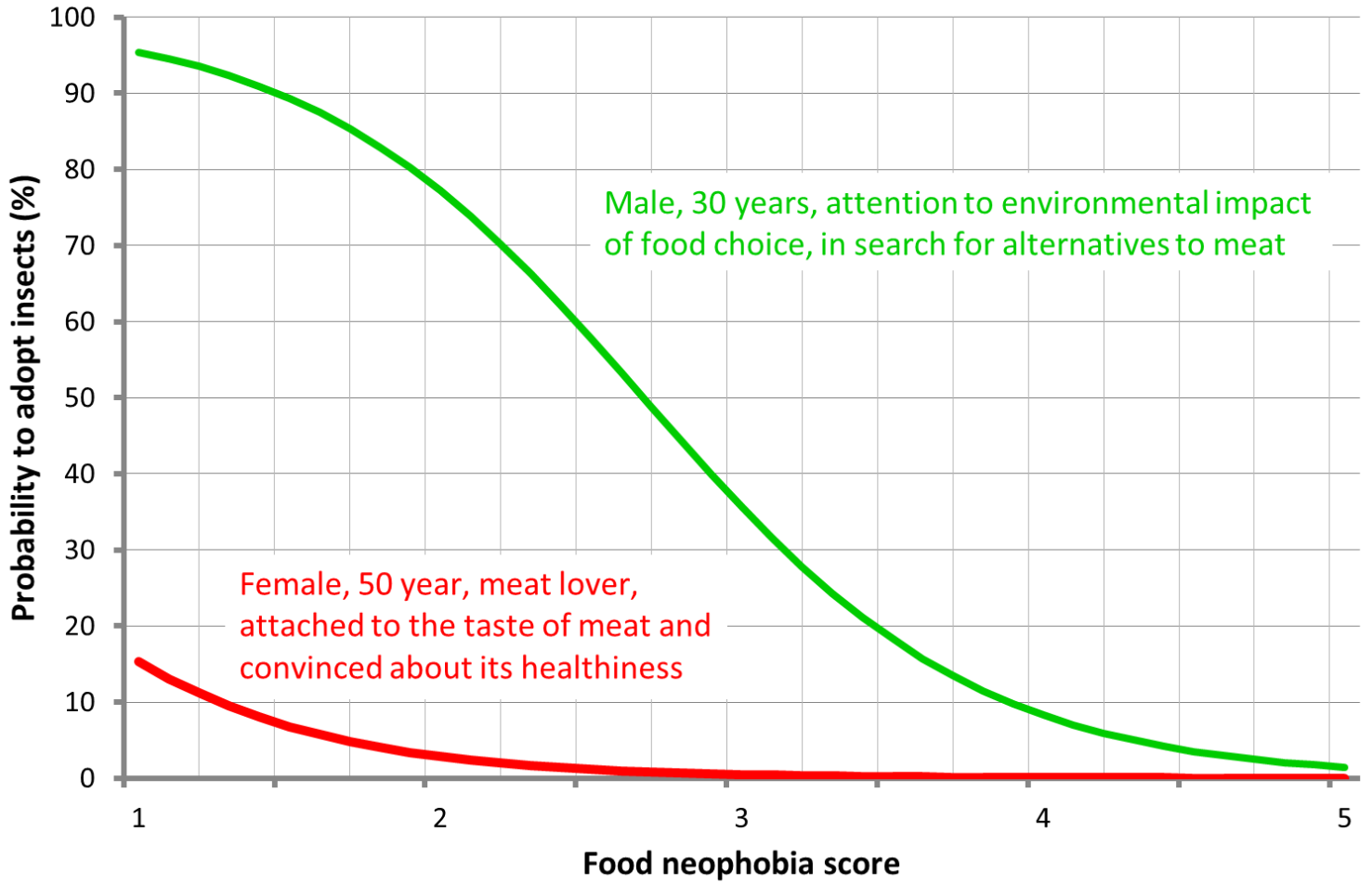

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2. Barriers vs. motives shaping consumers' willingness to eat **cultured meat**

Source: Verbeke, Hung, Baum, & De Steur (2021) Livestock Science **253**

Cultured meat attribute perceptions

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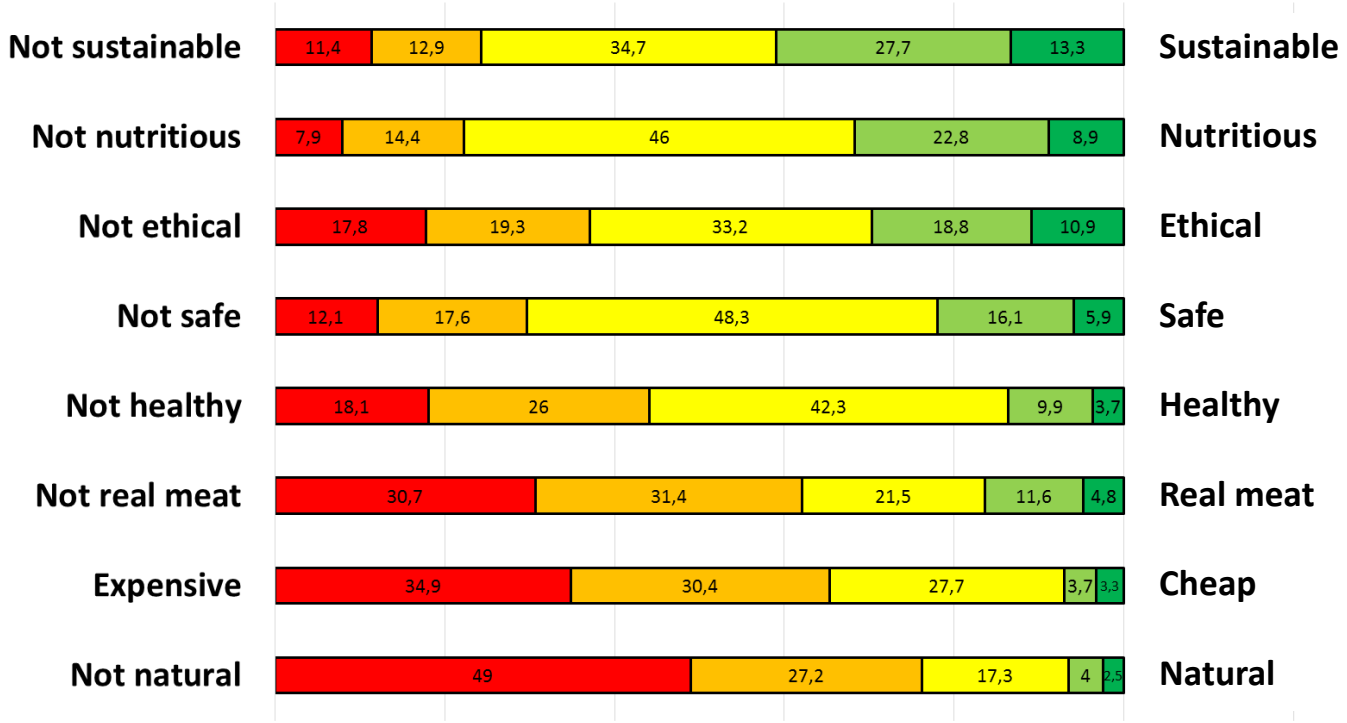
To what extent do you believe cultured meat will be…, n=404



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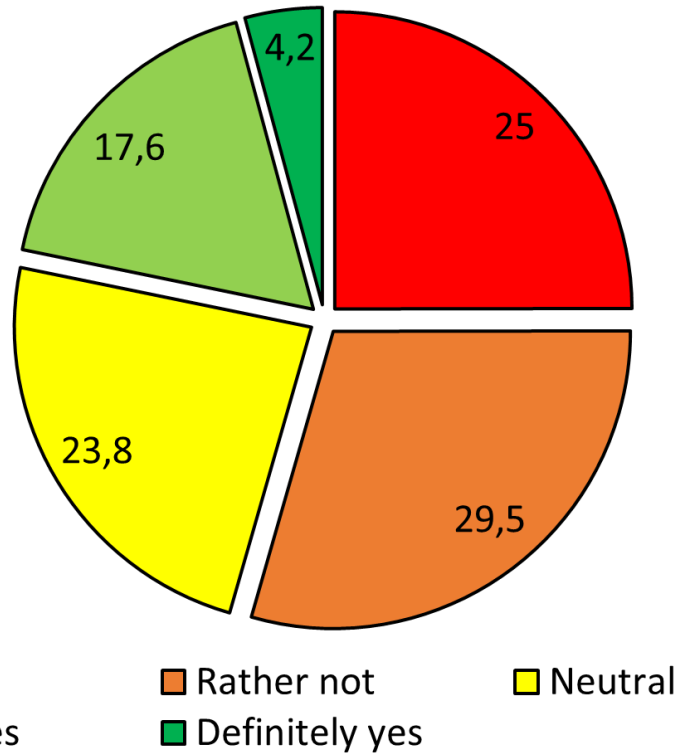
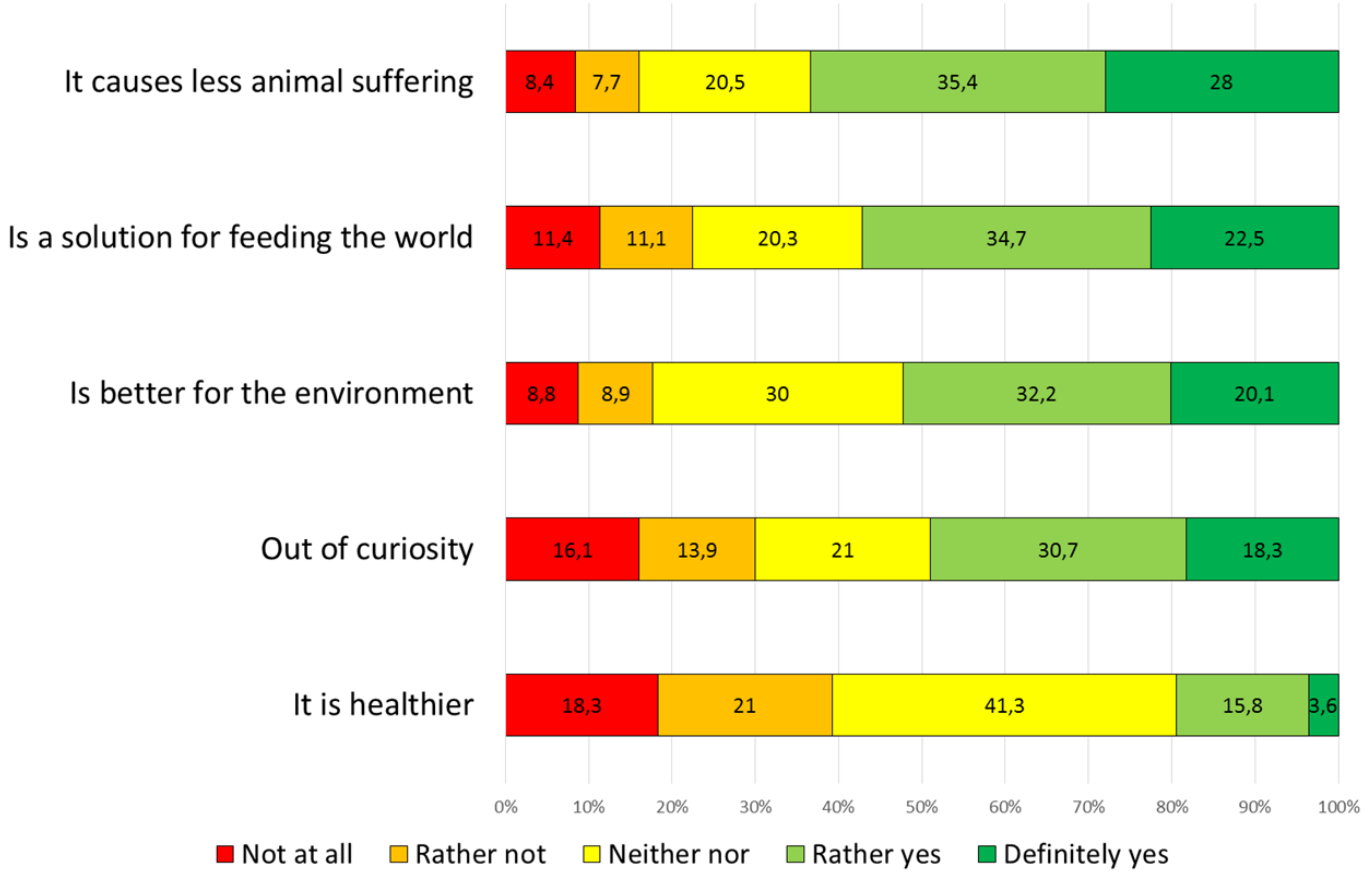
Willingness-to-eat

I would be willing to eat cultured meat as an alternative to conventional meat, n=404



Motives / benefits

Why [one] would consider to eat cultured meat, n=404



Barriers / risks

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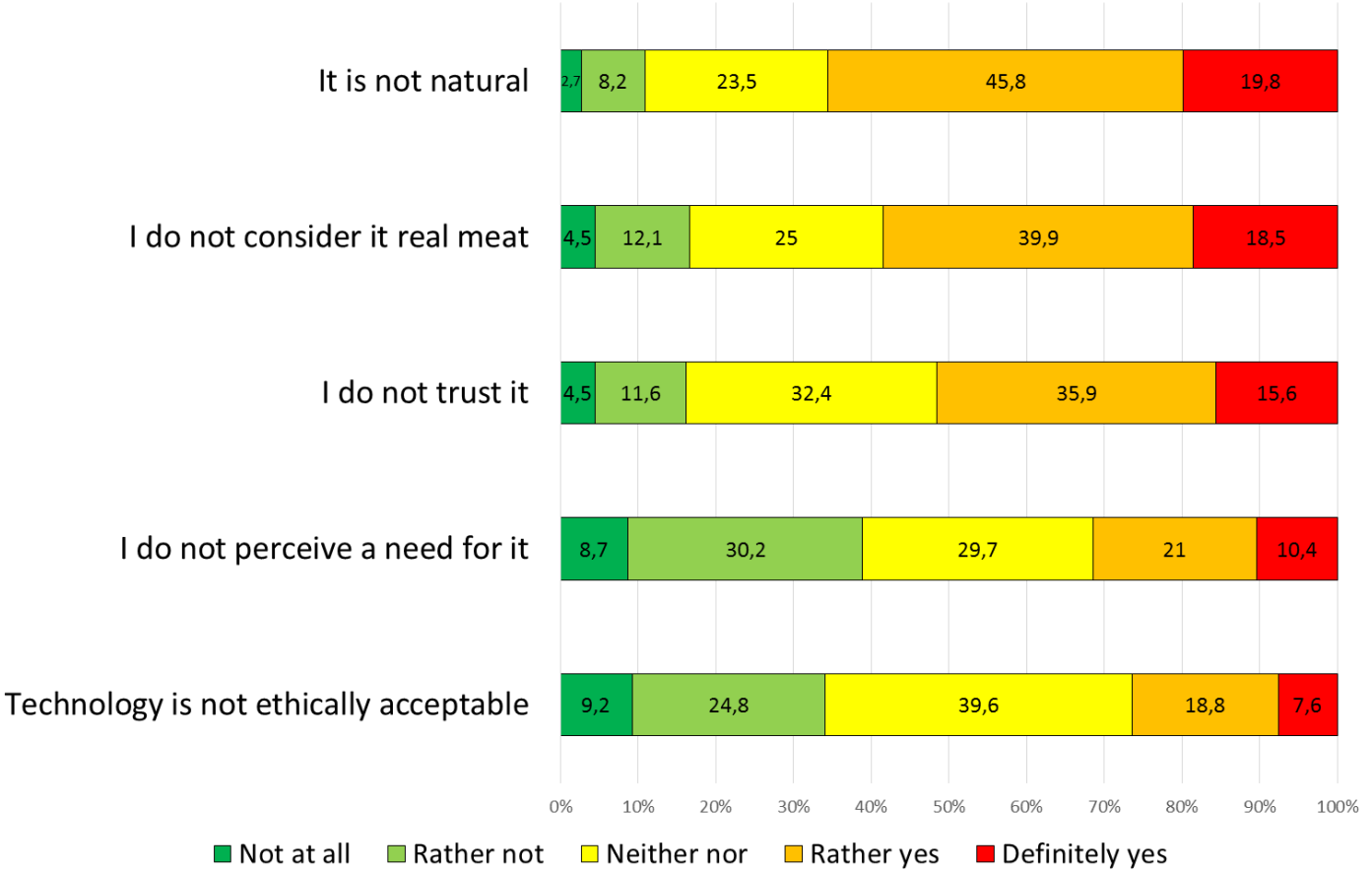
Why [one] would not consider to eat cultured meat, n=404



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Binary logistic modeling results

Table 3
Descriptive statistics of dependent and explanatory variables ($n = 398$).

Variable	Label	Mean (S.D.)
Dependent variable (binary)		
Willingness to eat cultured meat (0=no; 1=yes)	CulturedMeat	0.21
Explanatory variables		
Gender (0=female; 1=male)	Male	0.37
Age (years)	Age	40.91 (15.92)
Vegetarian (0=no; 1=yes)	Vegetarian	0.05
Strength of perceived barriers (5-point scale)	Barriers	3.58 (0.91)
Strength of perceived motives (5-point scale)	Motives	3.26 (0.94)
Treatment In-vitro (0=no; 1=yes)	In-vitro	0.33
Treatment Synthetic (0=no; 1=yes)	Synthetic	0.33
Treatment Cultured (0=no; 1=yes)*	Cultured*	0.34

Note: * used as reference category in the binary logistic regression model.

Table 4
Coefficient estimates (β and standard error (S.E.)), diagnostics (Wald statistic and p-value) and odds ratio (Exp(β), OR) from binary logistic regression explaining consumers' willingness to eat cultured meat as a substitute for conventional meat ($n = 398$).

Variable	β	S.E.	Wald	p-value	Exp(β), OR
Gender (male)	2.087	0.513	16.52	<0.001	8.06
Age	−0.056	0.015	14.63	<0.001	0.95
Vegetarian	−2.672	1.297	4.24	0.039	0.07
Barriers	−3.412	0.461	54.87	<0.001	0.03
Motives	2.794	0.469	35.41	<0.001	16.34
Treatment_In_vitro	0.907	0.527	2.97	0.085	
Treatment_Synthetic	0.199	0.575	0.12	0.729	
Constant	0.384	1.561	0.06	0.806	

Notes: Goodness of fit: Nagelkerke R^2=0.75;% correct predictions = 92.0% vs. 79.1% for naive prediction. This binary logistic regression analysis identifies the key factors predicting the likelihood to be willing to eat cultured meat as a substitute for conventional meat (Yes/No). Barriers and motives are based on construct scores for, respectively, the three strongest perceived barriers and motives. Odds ratios (OR) represent the ratio between the probability that a person is willing or not willing to eat cultured meat as a substitute for conventional meat.

Perceived barriers (risks) emerged as being twice as powerful compared to motives (benefits) in shaping consumers' willingness to eat cultured meat

($1/OR_{risks}$ = 1/0.03 = 33.33; $OR_{benefits}$ = 16.34)

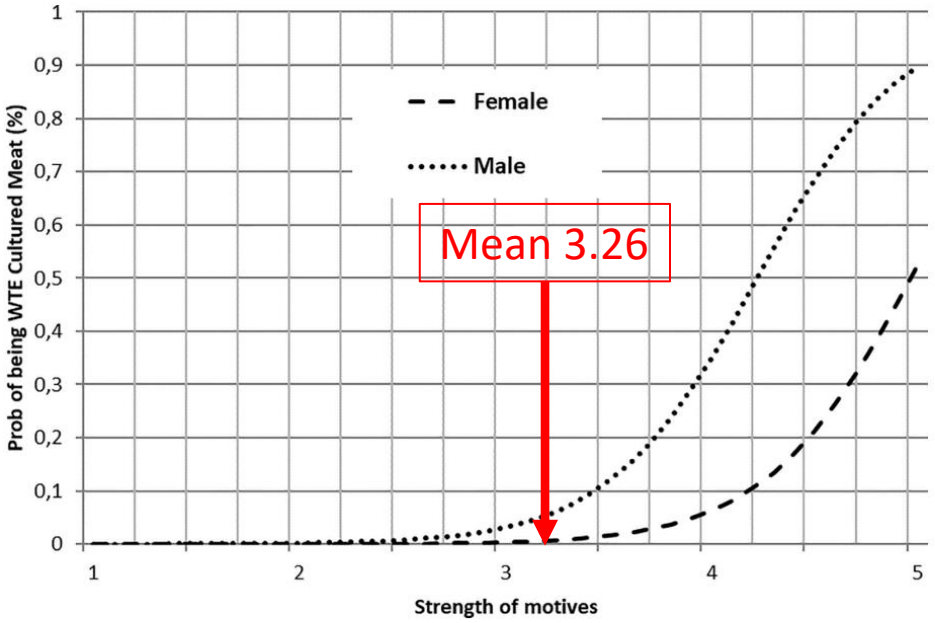


Fig. 1. Predicted probability p_i (%) of being willing to eat (WTE) cultured meat depending on the strength of motives for males and females and assuming mean values for the other explanatory variables in the model.

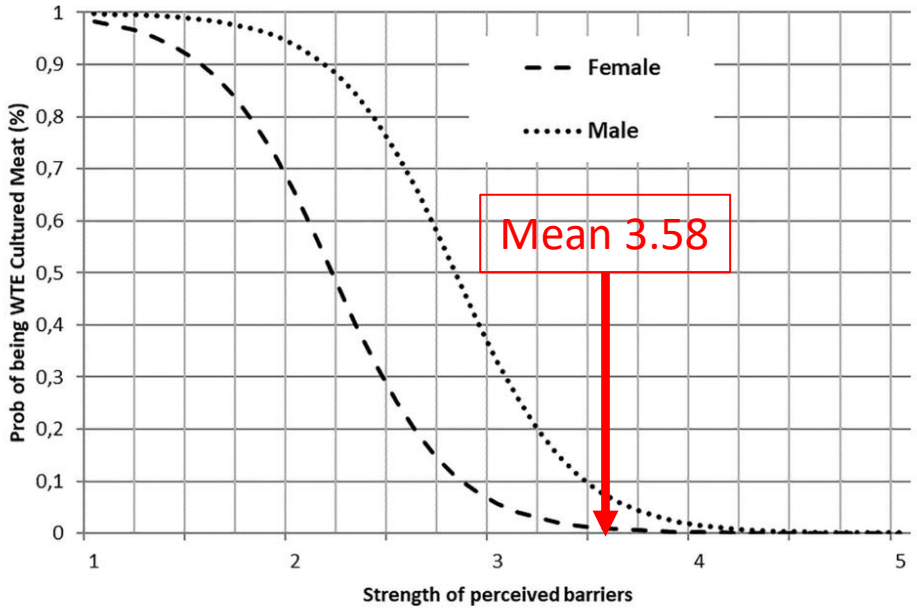


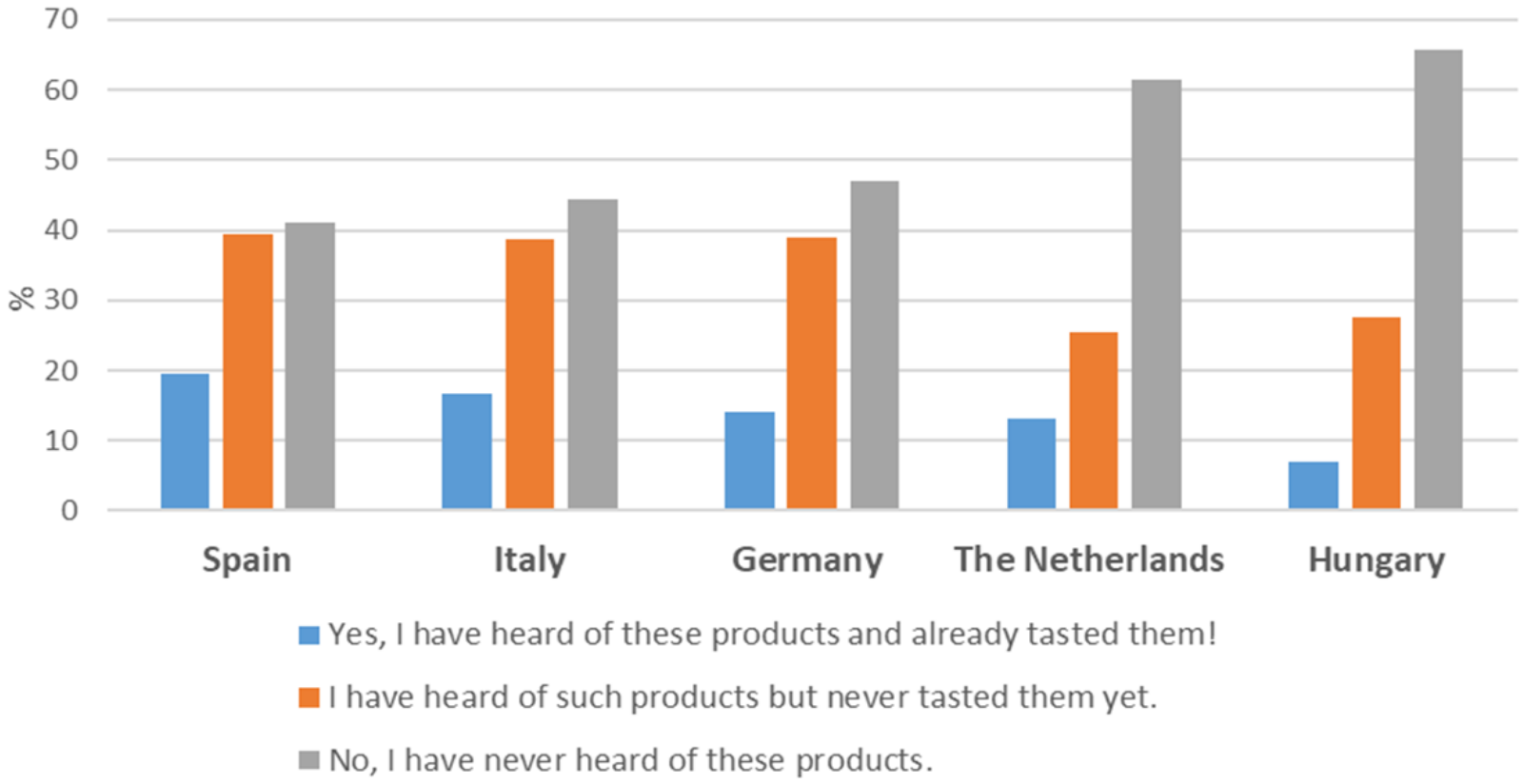
Fig. 2. Predicted probability p_i (%) of being willing to eat (WTE) cultured meat depending on the strength of perceived barriers for males and females and assuming mean values for the other explanatory variables in the model.

3. Consumer perception and interest in foods with **microalgae proteins**

Source: EU H2020 ProFuture
Van der Stricht, Hung, Fischer, Verbeke (2023) in preparation

ProFuture
Microalgae Protein Ingredients for the Food and Feed of the Future

Have you ever heard of or tried foods with microalgae proteins
(2021, n=3027)



Consumer perception of foods with microalgae proteins
(2021, n=3027)

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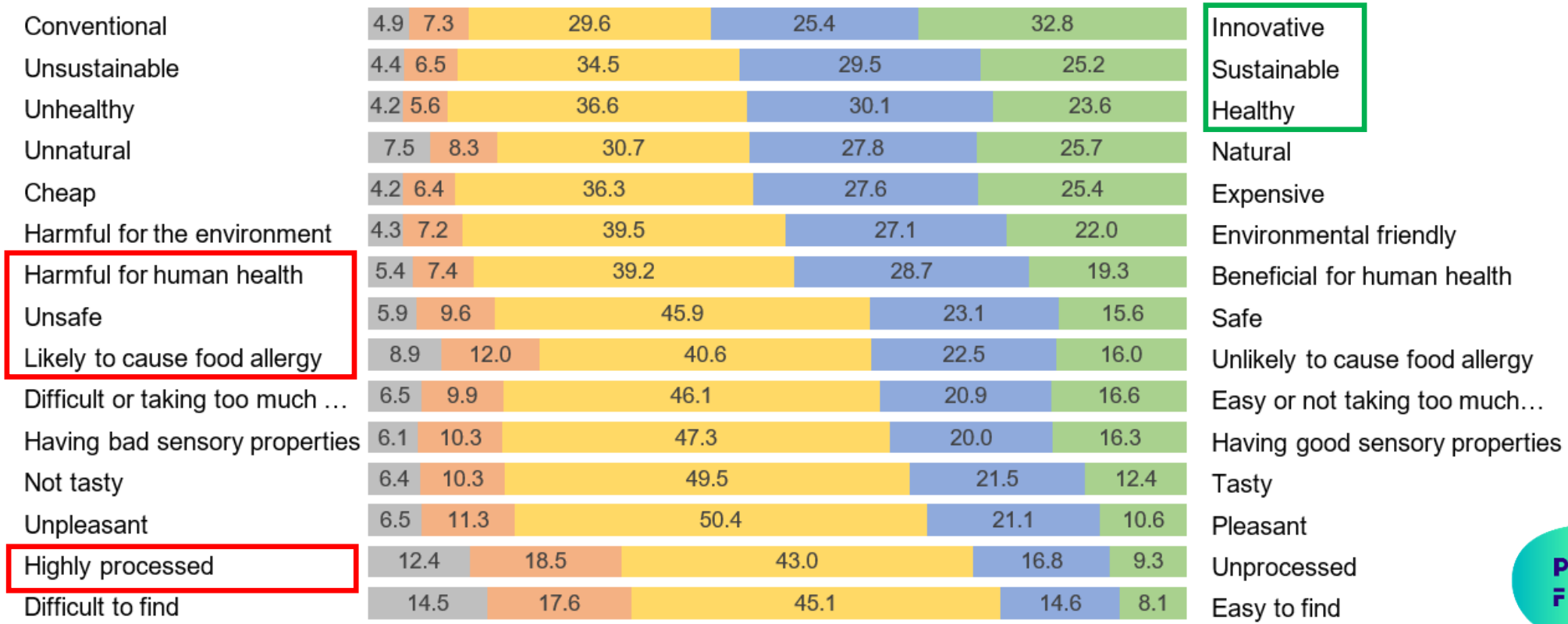

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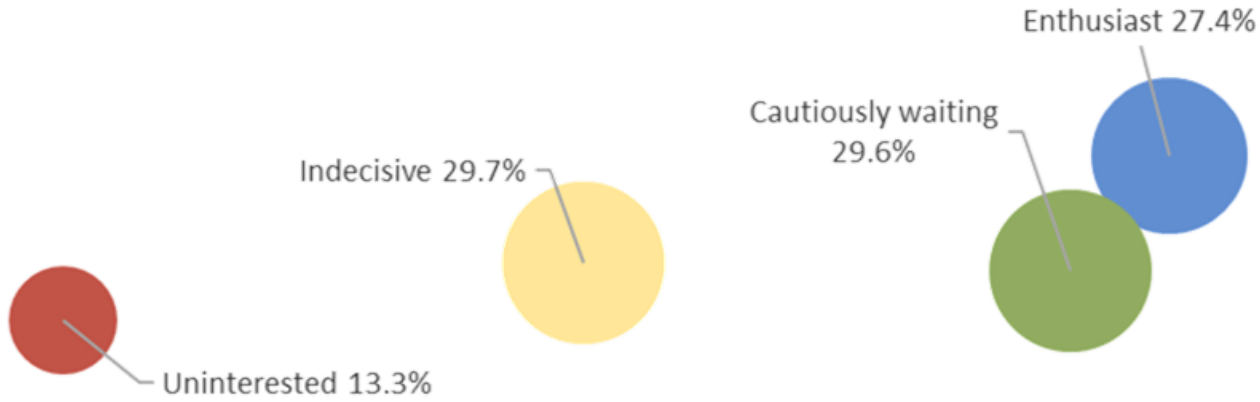
Consumer segments based on willingness to try and attribute perceptions of foods with microalgae proteins

(2021, n=3027) (preliminary results)



Increasing
- Food Neophobia
- Food Technology Neophobia

Increasing:
- General Health Interest
- Environmental concern
- Positive perceptions esp. nutrient-related
- Interest in related information

4. Conclusions

- Consumer acceptance of innovative food products cannot be taken for granted.
- Consumer research can shed light on the barriers and motives, perceived risks and benefits.
- A multitude of personal, product-related and environmental factors shape acceptance.
- Food (technology) neophobia emerges often as determinant of acceptance.
- Consumers are not all alike; segments matter.
- Issues pertain to perceived naturalness and ultra-high processing status.

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Thanks for your attention

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