

Bridging Science and the Consumer

Teagasc Food Research Centre

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Consumer food choice behavior: underlying preferences, motivations and attitudes

with a focus on alternative proteins

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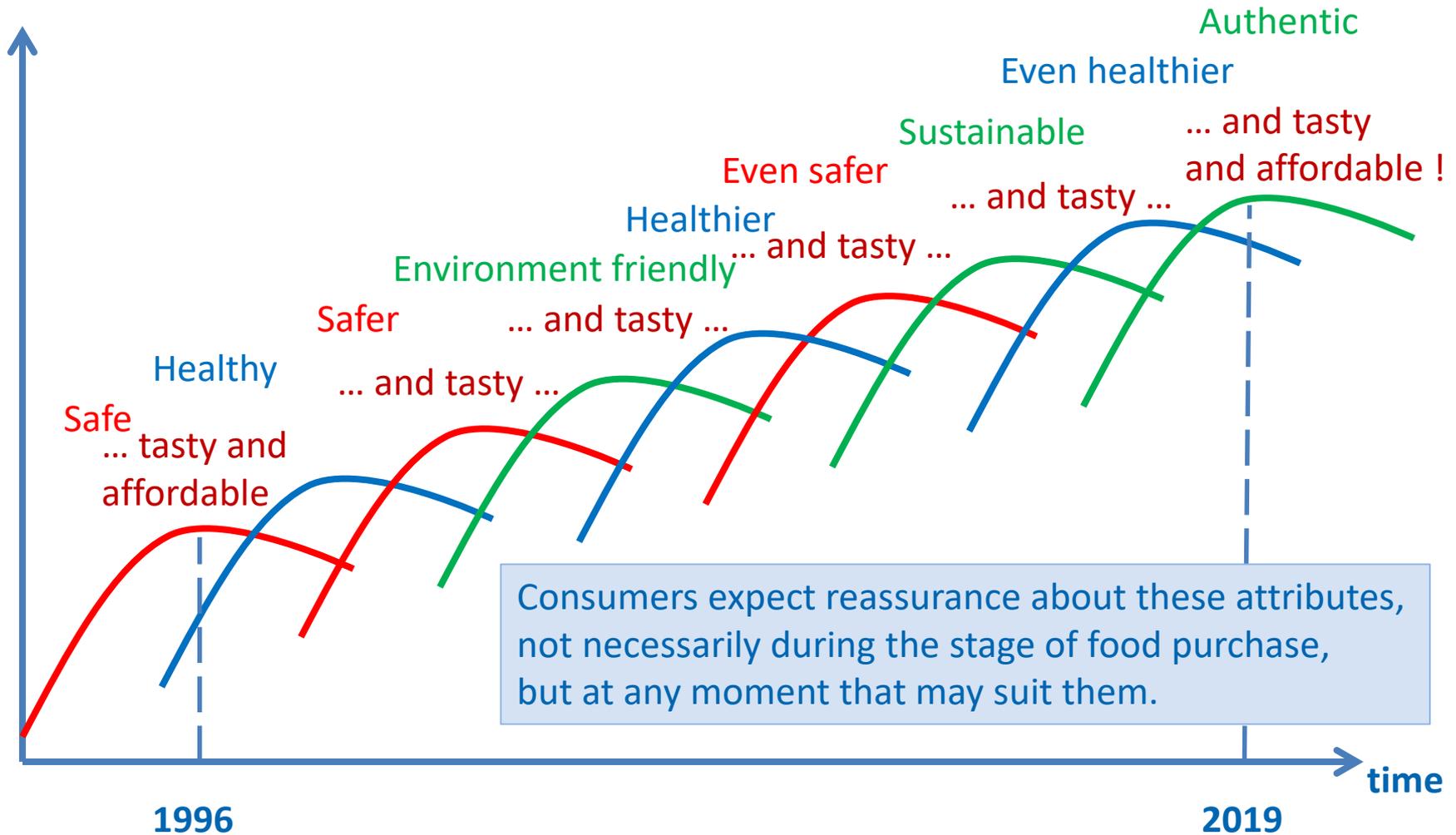
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Today's consumers and food

Consumer expectations from food production and products



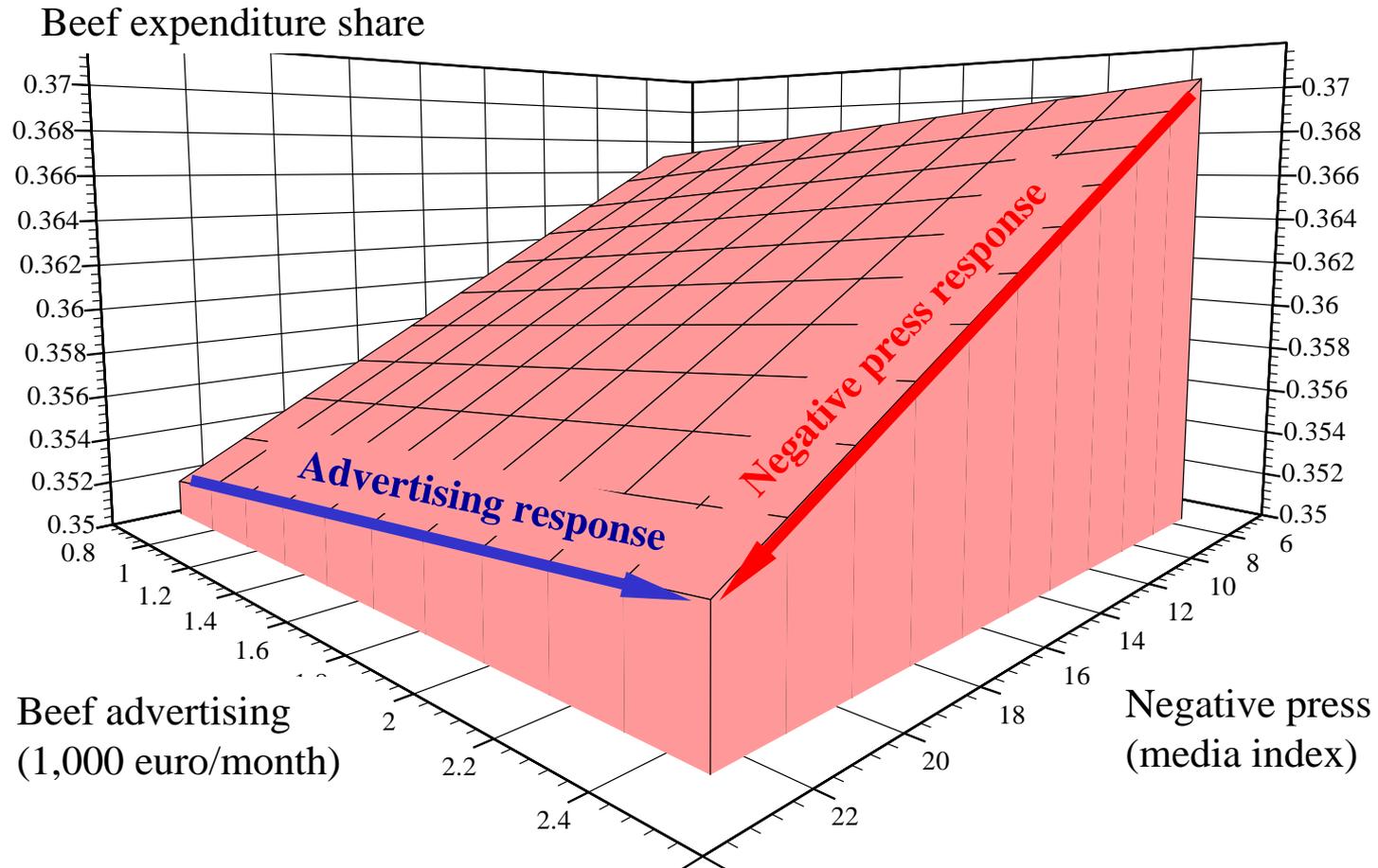
How consumers behaved

- Vigilant and concerned, even when hazards are not relevant;
- Overestimated some risks (esp. technological risks);
- Underestimated other risks (esp. lifestyle hazards);
- Did not differentiate greatly between risks within a category;
- Despite being uncertain, they often remained reluctant to information processing.

Areas of change in public and consumer attitudes towards agriculture and food

1. Interest in **Extrinsic Quality** and related **Information** (availability)
2. Safety less dominant, while **Health** and **Sustainability** gain share
3. **Process quality, Eating quality, and Convenience**
4. Concern for the **Environment** and attention to **Ethical issues**
5. Mostly as a Citizen, less as Consumer: **Citizen-Consumer Duality**
6. **Acceptability/Acceptance** of innovations not for granted

Power of mass media negative publicity versus positive news (here: BSE versus generic advertising)



- Ratio of slopes = 5 to 1
- Five units of positive news needed to offset one unit negative press

Five
Expensive
Working slowly
Shorter carry-over

←→

One
For free
Working fast
Longer carry-over



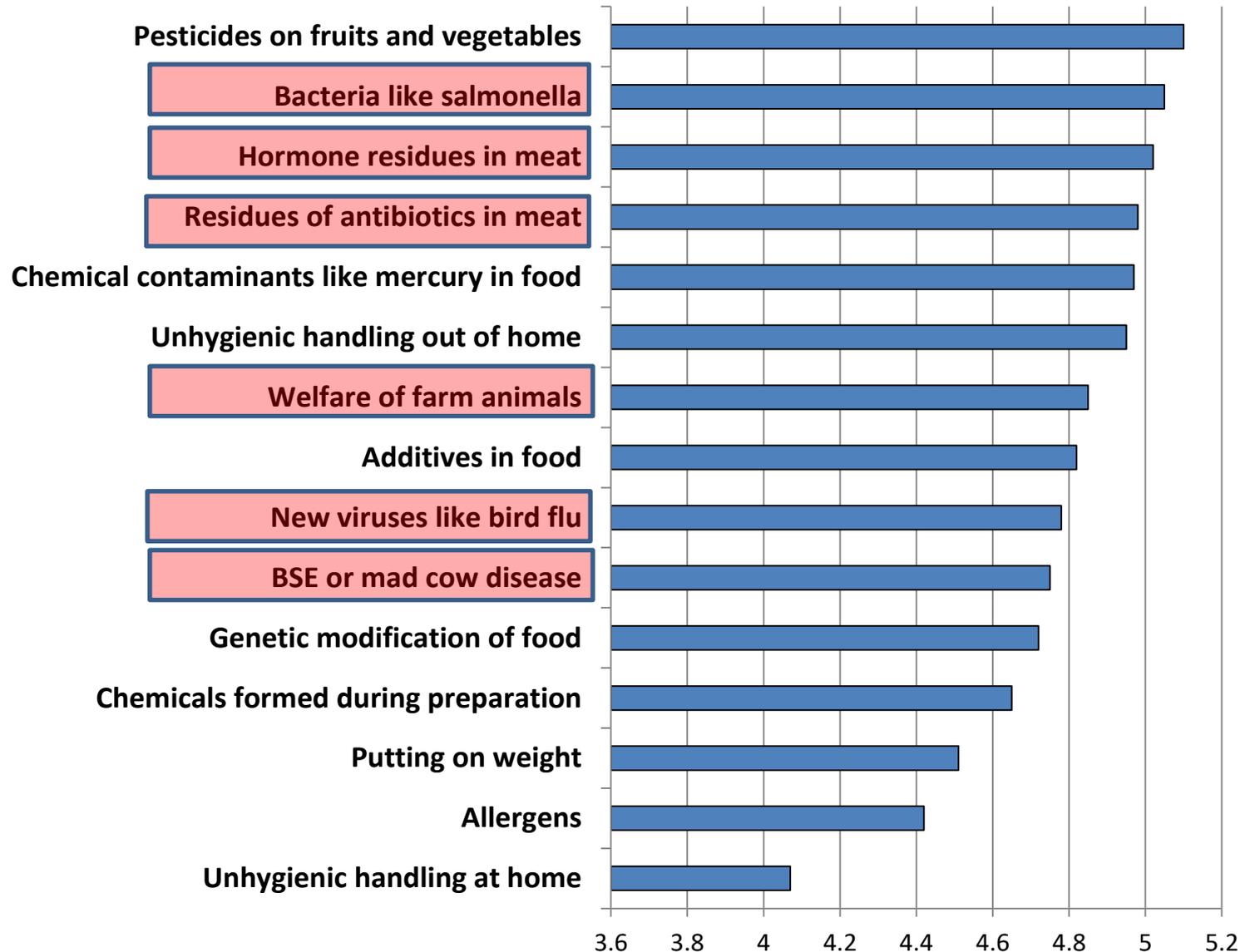
Providing easy decision rules



More information on food labels ?

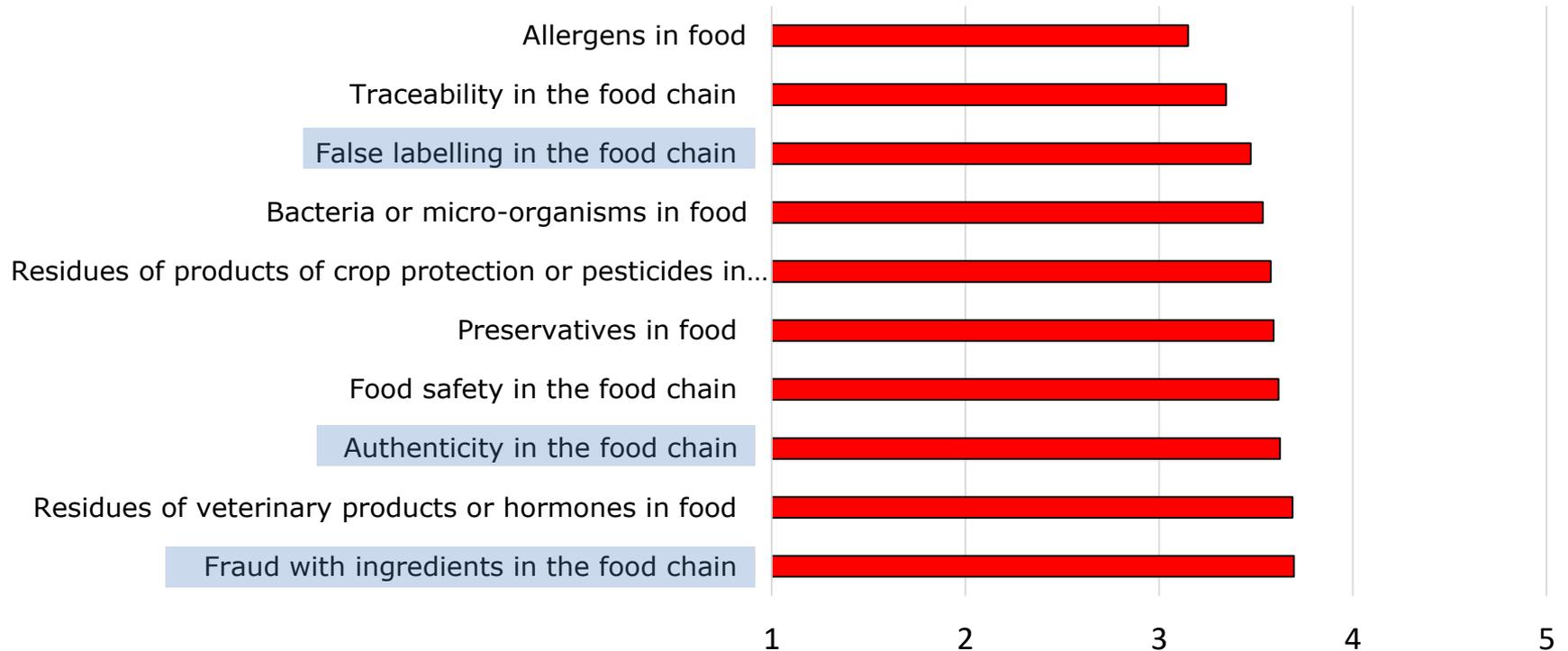
- Information overload yielding uncertainty
- Best strategy for consumers to make a decision ?
 - Ignore the information
 - Process information systematically
 - Seek and use heuristics (easy decision rules; e.g. brands, labels)
 - Avoid and search for an alternative route (substitutes)

To what extent are you concerned about possible risks associated with food? (n=600; 2012; Belgium; ProSafeBeef study, mean 7-pt scale)



Consumers' concerns about food and the food chain

(n=474, Flanders, BE, 2017-2018)



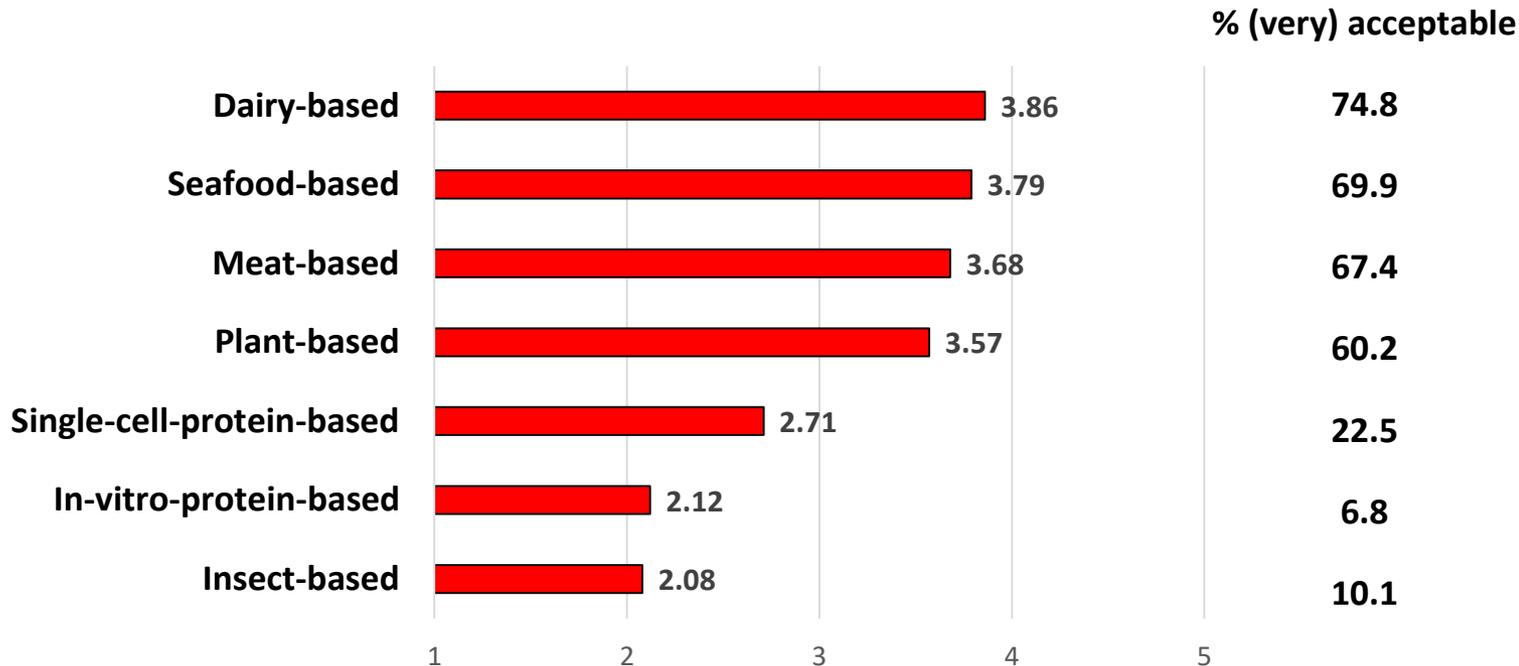
One food group was “more than average” involved in debates and affected:

Meat

As a basic source of protein → “The protein transition”

To what extent do you accept to eat protein-enriched food products that contain the following sources of protein ?

(n=1,750, UK, NL, SP, PL, FI – age 65-90, 2017)



Plant-based food

Health, sustainability, perceived match or mismatch

Food Policy 69 (2017) 46–57



Contents lists available at [ScienceDirect](#)

Food Policy

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Healthy, sustainable and plant-based eating: Perceived (mis)match and involvement-based consumer segments as targets for future policy



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Involvement
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Sustainable eating

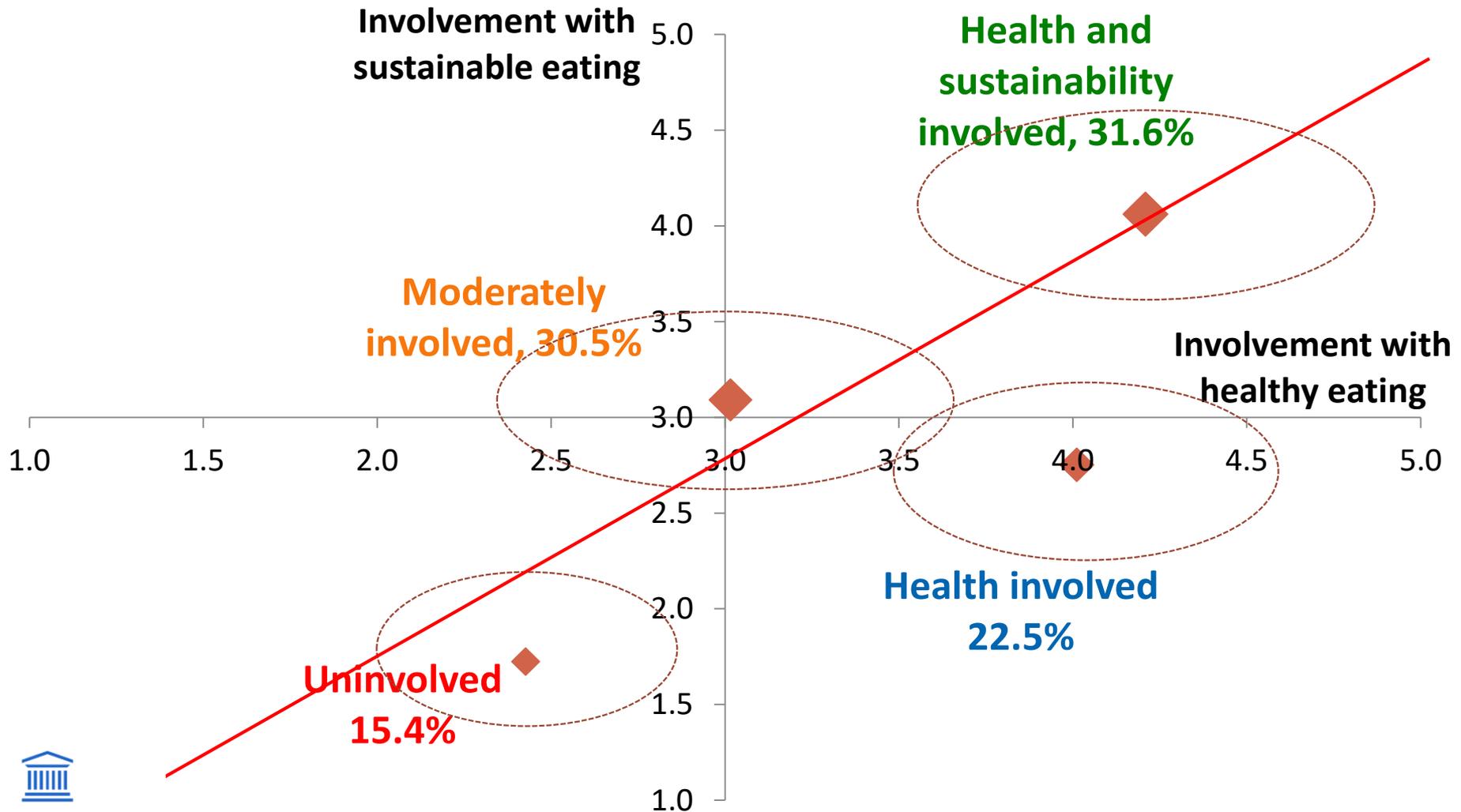
ABSTRACT

Given the inseparable environmental and health impact of dietary habits, integrating health and sustainability goals has become a highly topical issue in policy development and communication to encourage consumers to adopt healthier and more sustainable diets. Increasing evidence indicates that it is possible to develop diets that are both environmentally sustainable and healthy, but their potential success largely depends on consumers' willingness and ability to change their behavior. This study investigates consumer perceptions of the match, or mismatch, between healthy and sustainable diets, and gives insight into consumers' motivation to eat healthily and sustainably, as measured by involvement. Data were collected in Spring 2014 through a cross-sectional quantitative online survey with samples representative for age, gender and region in four European Union (EU) countries (United Kingdom, Germany, Belgium, and the Netherlands) (n = 2783). The images of a healthy diet, a sustainable diet and a plant-based diet were found to be highly compatible based on a strongly observed match between European consumers' perceptions of these concepts. Half of the participants were highly involved in healthy eating and one third in both healthy and sustainable eating. Informational food policy actions targeting both healthy and sustainable food consumption behavior are recommended to address issues relevant to the target segments, taking into account their levels of involvement. Increasing consumers' motivation and involvement in health and sustainability emerges as a key trigger for increasing healthy and sustainable eating.

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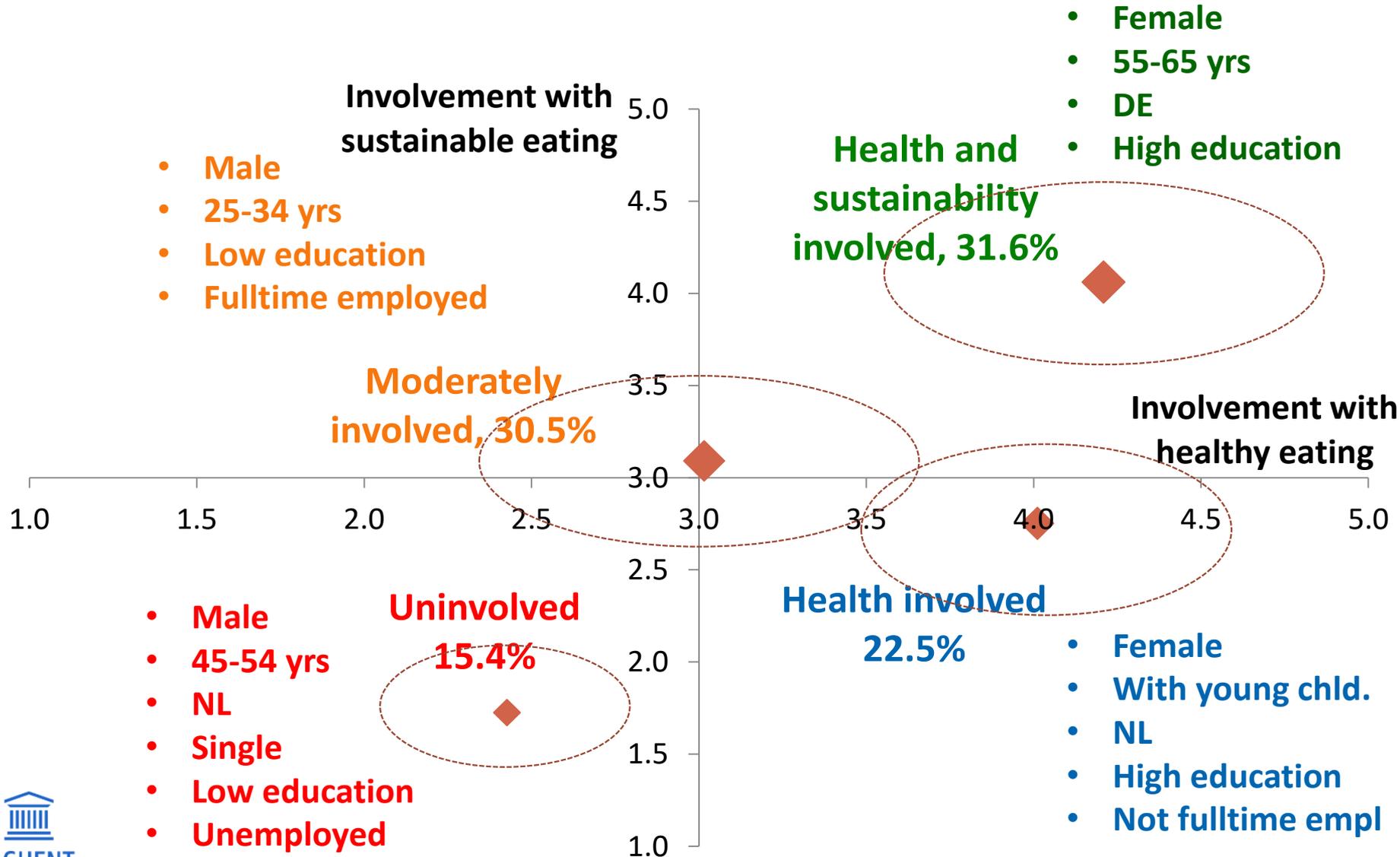
Consumer segments based on involvement with healthy and sustainable eating

(n=2,720; 2014; BE, NL, UK, DE)



Segment profiles

(n=2,720; 2014; BE, NL, UK, DE)

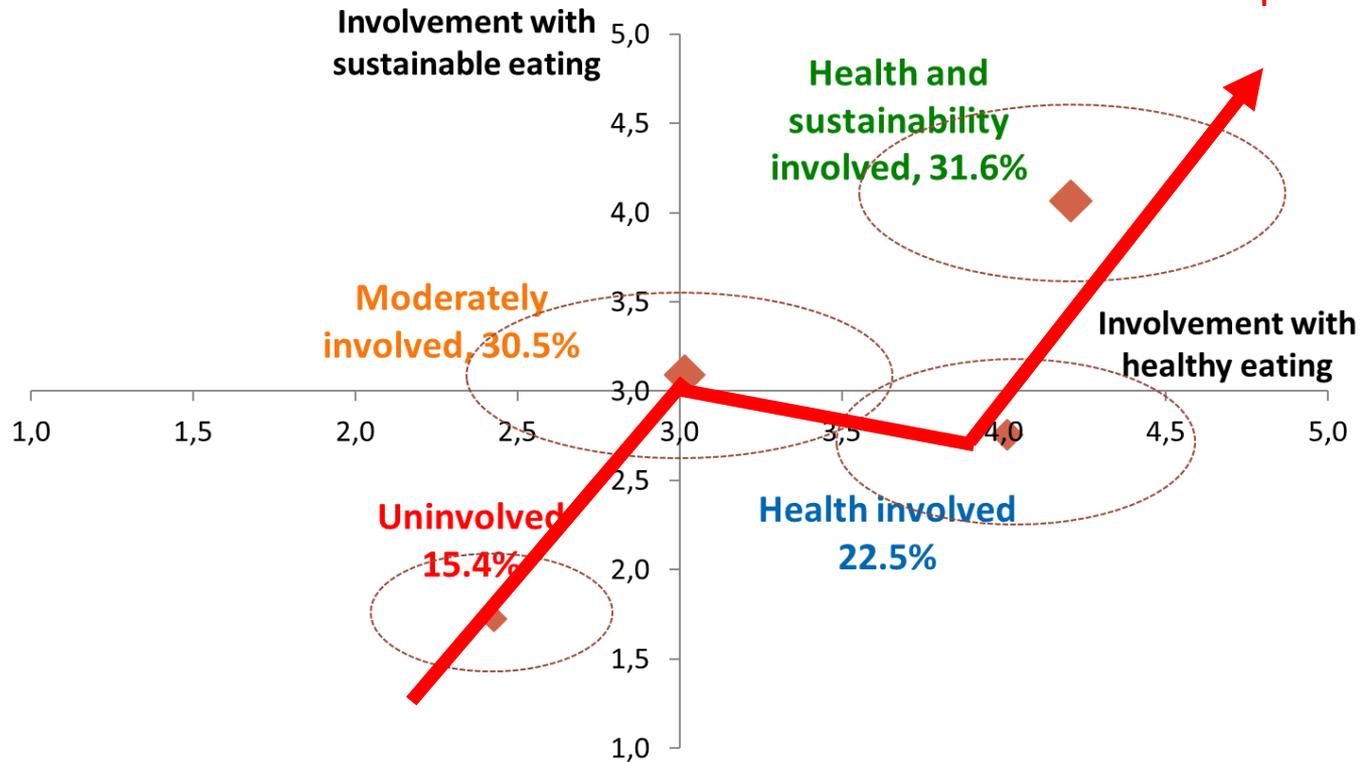


Segment profiles

(n=2,720; 2014; BE, NL, UK, DE)

Increasing levels of:

- Food-related health concerns
- Self-reported healthy eating
- Subjective healthiness of own diet
- Attitude towards and consumption of plant-based diets



Strong perceived match between a healthy and a sustainable diet

but also ... a stronger association of both concepts with a plant-based rather than an animal-based diet

- ◆ Healthy diet
- Sustainable diet
- ▲ Plant-based diet



Fig. 1. Perception of a healthy, sustainable and plant-based diet (5-point semantic differential scale)¹ (n = 2783). (¹For each of the items, Wilcoxon matched-pair signed-ranks tests were performed to test for differences between healthy, sustainable and plant-based diets (p < 0.05). Only five pairs were not statically different as indicated by the following superscripts: ^a No significant differences between healthy and sustainable diet; ^b No significant differences between healthy and plant-based diet; ^c No significant differences between sustainable and plant-based diet.)

Insects as food

Food Quality and Preference 39 (2015) 147–155



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Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual



Profiling consumers who are ready to adopt insects as a meat substitute in a Western society



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ABSTRACT

This study investigates the readiness of consumers in a Western society, where traditional meat consumption prevails, to adopt insects as a substitute for meat. Using cross-sectional data ($n = 368$) and binary logistic regression modeling, the study identifies gender, age, familiarity, food neophobia, convenience and environmental food choice motives, as well as meat-related attitudes and future meat consumption intentions as significant predictors. The predicted likelihood of adopting insects as a substitute for meat is 12.8% [95% CI: 6.1–19.4%] for males and 6.3% [95% CI: 2.8–9.9%] for females, other predictor variables held constant at their mean value. People who claim to be familiar with the idea of eating insects have a 2.6 times higher likelihood, and consumers who intend to reduce fresh meat intake are up to 4.5 times more likely to adopt insects. Food neophobia makes the largest contribution to consumers' readiness to adopt insects: a one-unit increase in the food neophobia score is associated with a 84% decrease in the predicted odds of being ready to adopt insects. A stronger convenience orientation in food choice and a higher interest in the environmental impact of food choice increase the likelihood of adopting insects by 75% and 71% per unit increase in these predictors' scores, respectively. By contrast, a one-unit stronger belief that meat is nutritious and healthy, and a one-unit higher importance attached to taste for meat lower the predicted odds by 64% and 61%, respectively. This study reveals that the most likely early adopters of insects as a novel and more sustainable protein source in Western societies are younger males with a weak attachment to meat, who are more open to trying novel foods and interested in the environmental impact of their food choice.

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Potential determinants of willingness-to-adopt insects as an alternative to meat

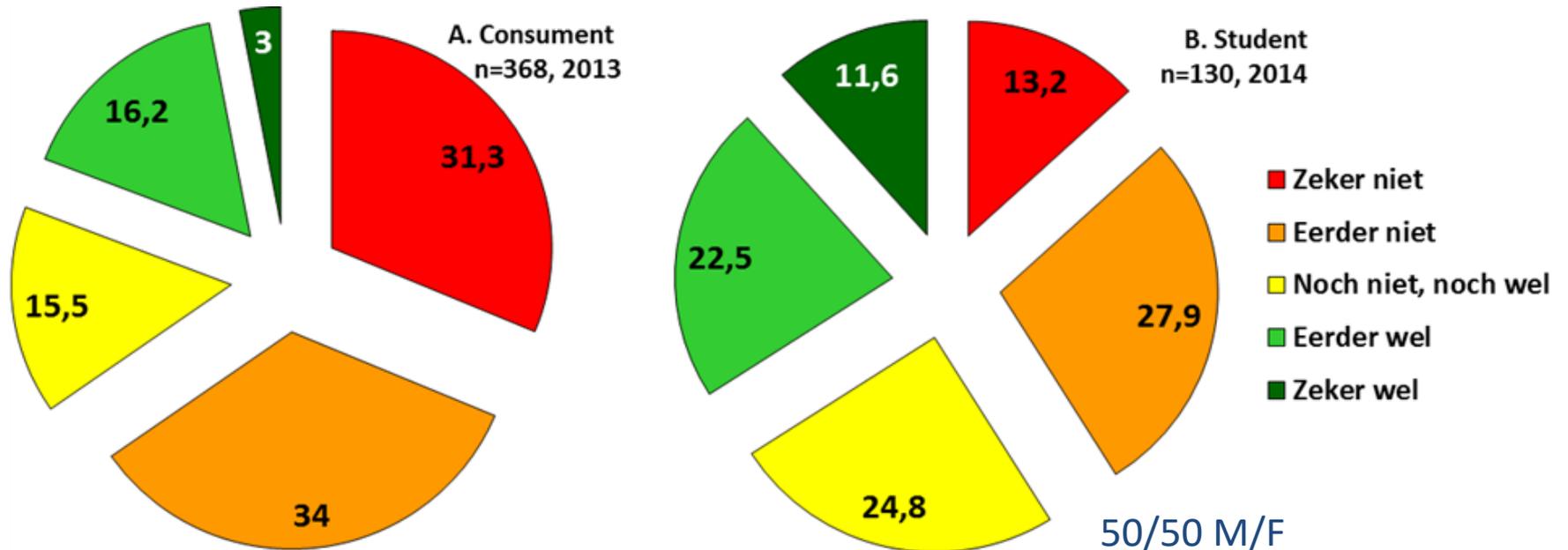
- Socio-demographics:
 - Gender
 - Age
 - Education level
- Neophobia:
 - Food neophobia
 - Food technology neophobia
- Food-related attitudes:
 - Interest in health
 - Attention environmental impact
 - Interest in convenience
- Familiarity with entomophagy
- Involvement with meat:
 - Importance of meat taste
 - Conviction that eating meat is nutritious and healthy
- Intention to reduce meat consumption in the coming year

Method

- Data collection December 2013
- n = 368 meat consumers
- 39% men; 61% women
- Age 18-79 years; average age 42 years
- Representative for region (5 provinces of Flanders)
- 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

Willingness-to-adopt insects

Representative sample of consumers vs. Convenience sample of students



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

Statistical modeling

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

$$\begin{cases} y_i = 1 & \text{if } z_i > 0 \\ y_i = 0 & \text{if } z_i \leq 0 \end{cases}$$
 Willingness to adopt (WTA) insects is modeled as a probability that is determined by personal characteristics, attitudinal and behavioural variables using binary logistic regression

$$p_i = \text{prob}(y_i = 1) = \frac{e^{z_i}}{1 + e^{z_i}} = \frac{e^{\beta_0 + \sum_{k=1}^K \beta_k X_{ki}}}{1 + e^{\beta_0 + \sum_{k=1}^K \beta_k X_{ki}}} \text{ or}$$

$$\begin{aligned} \log\left(\frac{p_i}{1 - p_i}\right) &= z_i = \beta_0 + \sum_{k=1}^K \beta_k X_{ki} + \varepsilon_i \\ &= \beta_0 + \beta_1 \text{Male}_i + \beta_2 \text{Age}_i + \beta_3 \text{Edu}_i + \beta_4 \text{Fam}_i + \beta_5 \text{FNS}_i \\ &\quad + \beta_6 \text{FTNS}_i + \beta_7 \text{FHealth}_i + \beta_8 \text{FConc}_i + \beta_9 \text{FEnv}_i \\ &\quad + \beta_{10} \text{MTate}_i + \beta_{11} \text{MNutr}_i + \beta_{12} \text{MRed}_i + \varepsilon_i \end{aligned}$$

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.

Results

(n=368; 2013; Flanders, Belgium)

Table 3

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

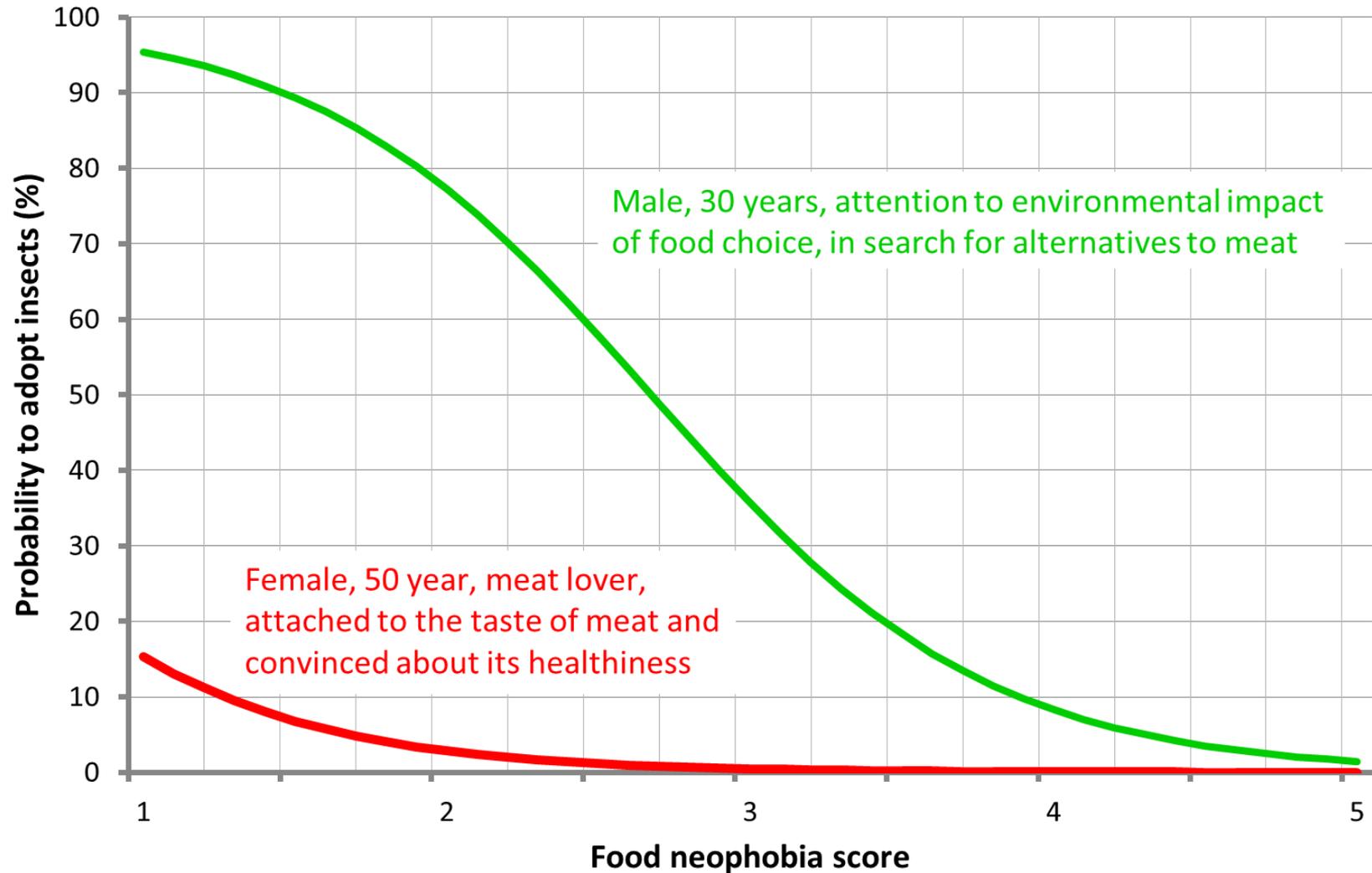
Variable	β	S.E.	Wald	Sig.	Exp (β)
Gender (male)	0.774	0.363	4.553	0.033	2.169
Age	-0.028	0.012	5.256	0.022	0.973
Education	0.005	0.421	0.000	0.991	1.005
Fam	0.957	0.447	4.580	0.032	2.604
FNS	-1.811	0.361	25.125	<0.001	0.164
FTNS	-0.788	0.252	9.741	0.002	0.455
FHealth	0.416	0.239	3.014	0.083	1.515
FConv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

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 **environ-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

Simulated probability of adopting insects



“Western early adopters” of insects as an alternative to meat are:

Young men with low food neophobia, who pay attention to the environmental impact of their food choice, and plan to reduce their meat consumption.

The probability that this type of consumer is willing to adopt insects amounts more than 90%.

They constituted less than 2% of our study sample



Study reveals consumer group most likely to try insects as a meat substitute: hipsters.
<http://t.co/kHhmBzi5K5>



30-Aug-2014



Study reveals consumer group most likely to try insects as a meat substitute: hipsters.
<http://t.co/kHhmBzi5K5>



30-Aug-2014

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Study reveals consumer group most likely to try insects as a meat substitute: hipsters.
<http://t.co/kHhmBzi5K5>



30-Aug-2014



Insects as feed

Animal Feed Science and Technology 204 (2015) 72–87



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Insects in animal feed: Acceptance and its determinants among farmers, agriculture sector stakeholders and citizens



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ABSTRACT

The use of insects in animal feed is a potential avenue to improve the sustainability of animal diets and meet the growing global demand for livestock products. Yet, little is known about the attitudes towards and willingness-to-accept insect-based animal feed and foods. This study presents findings from cross-sectional data collected in January 2015 from a sample of 415 farmers, agriculture sector stakeholders and citizens in Flanders, Belgium. Attitudes towards the idea of using insects in animal feed were generally favourable, most notably for fish and poultry feed. Two thirds of the study participants were willing-to-accept the use of insects in animal feed. The foods obtained from animals fed on insect-based feed were widely accepted. Farmers were more critical – but still generally positive – as compared to stakeholders and citizens. Insect-based feed was perceived to be more sustainable, to have a better nutritive value, but a lower microbiological safety as compared to conventional feed. In addition, the resulting foods were perceived to be more sustainable, nutritious and healthy, but at the risk of presence of off-flavours and allergens. Perceived benefits of using insects in animal feed pertained mainly to lowering the dependency on protein imports, and better valorisation of organic waste. Benefit perceptions were stronger and outweighed risk perceptions as a determinant of accepting the use of insects in animal feed. However, the strongest determinant of acceptance was a person's own willingness-to-eat insect-based foods. Overall, the findings of this study indicate a positive atmosphere and momentum for change towards the adoption of insects as a new ingredient in animal feed.

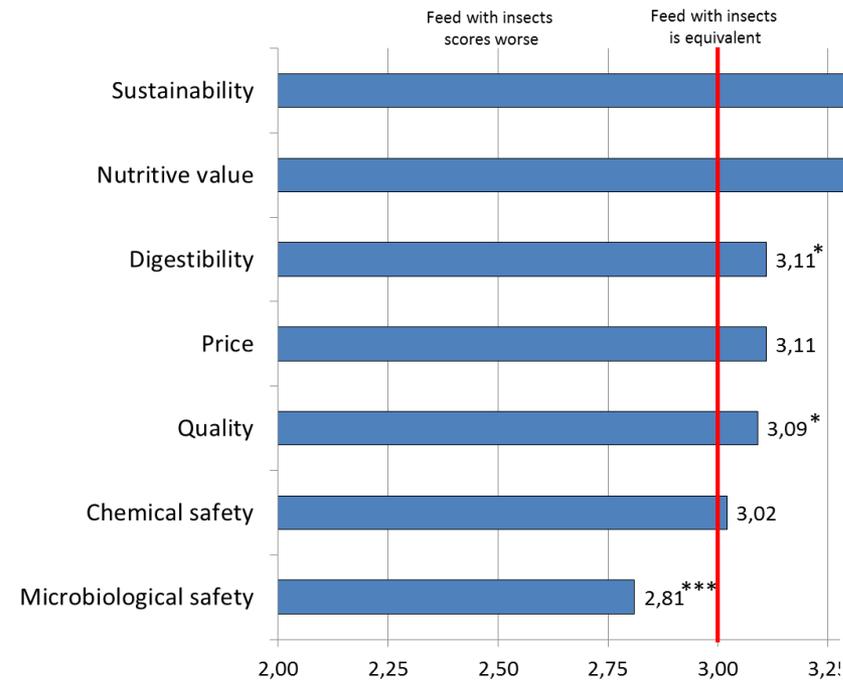
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Method

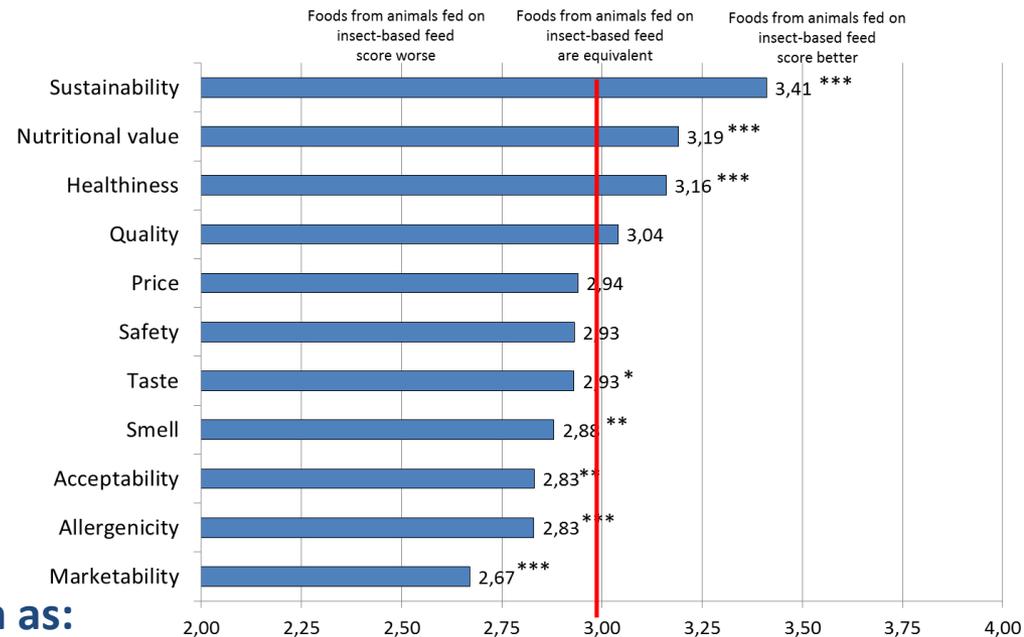
- Data collection January 2015
- n = 415 farmers, agriculture sector stakeholders, citizens
- Including 151 livestock farmers
- 67% men; 33% women
- Average age 37 years
- Recruitment and survey administration during agricultural fair in Flanders, Belgium

Perception of insect-based feed and resulting foods

Animal feed with insects as compared to conventional feed



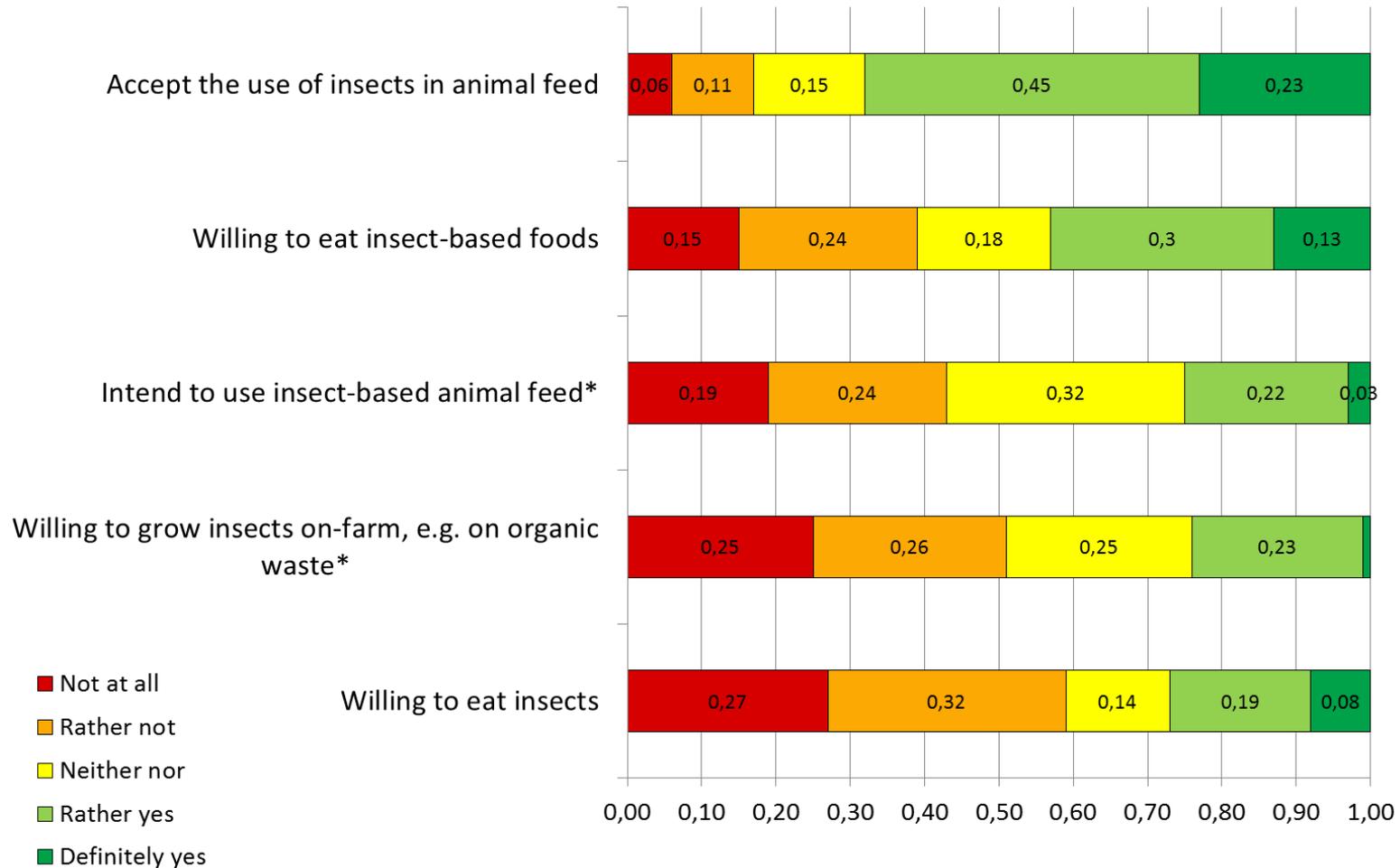
Foods from animals fed on insect-based feed as compared to conventional food



Insect-based feed and resulting foods seen as:

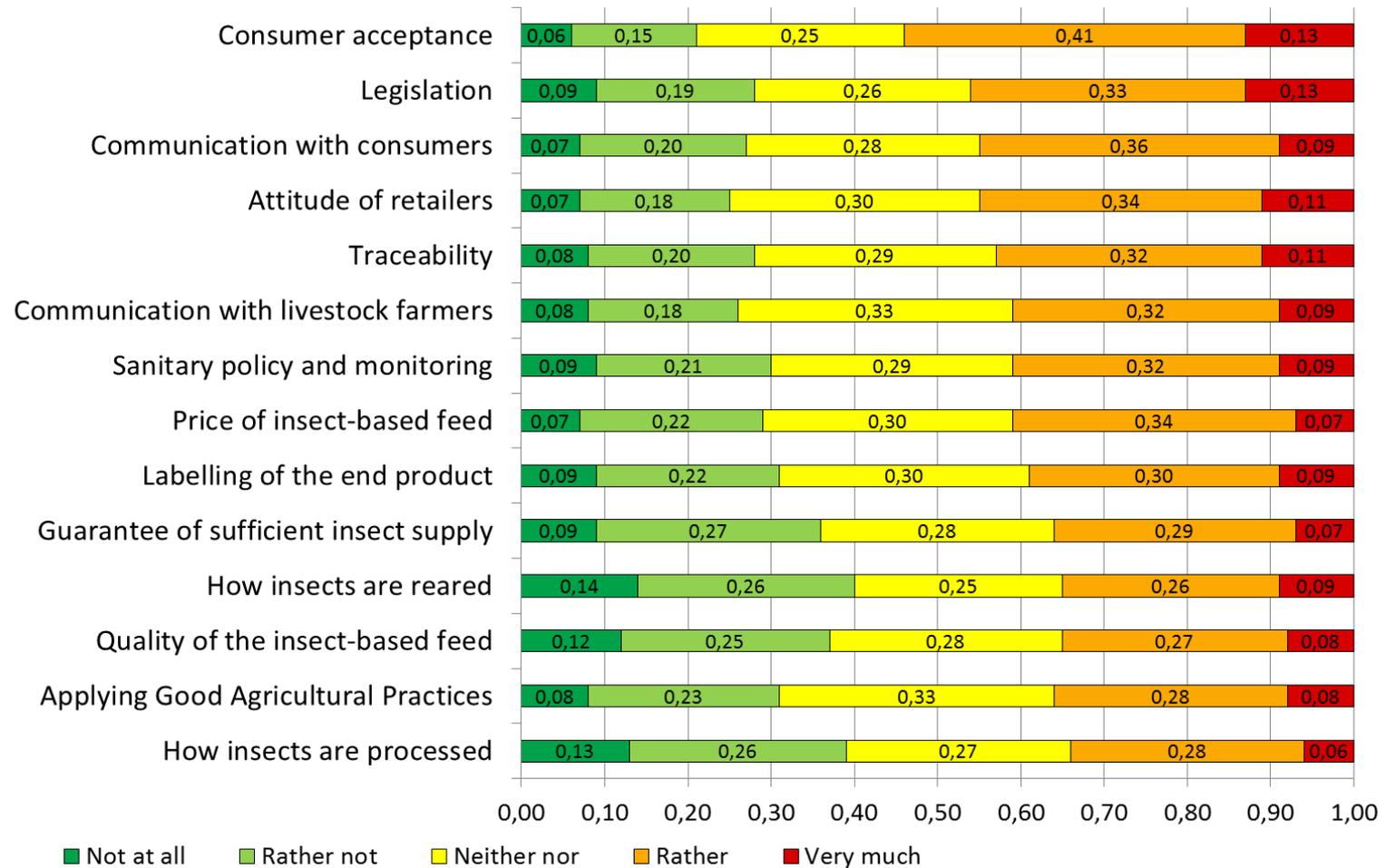
- more sustainable, nutritious and healthy
- Less microbiologically safe (feed)
- Allergenic, and a harder sell (foods)

Acceptance of the use of insects in animal feed and insect-based food



Perceived challenges facing the use of insects in animal feed

- Perceived market-related challenges dominant over perceived technological challenges
- “Consumer acceptance” seen as the major pitfall despite favourable personal WTA ...



Perceived benefits and risks

Top-3 perceived **benefits** (overall score 3.71)

- Lower dependence on foreign protein imports
- Better valorisation of organic waste
- Improved sustainability of livestock production

Top-3 perceived **risks** (overall score 3.04)

- Possible impact on biodiversity
- Introducing microbiological contamination in the food chain
- Competition with other agricultural activities

Cultured meat

Journal of Integrative Agriculture 2015, 14(2): 285-294

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'Would you eat cultured meat?': Consumers' reactions and attitude formation in Belgium, Portugal and the United Kingdom



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ABSTRACT

Cultured meat has evolved from an idea and concept into a reality with the August 2013 cultured hamburger tasting in London. Still, how consumers conceive cultured meat is largely an open question. This study addresses consumers' reactions and attitude formation towards cultured meat through analyzing focus group discussions and online deliberations with 179 meat consumers from Belgium, Portugal and the United Kingdom. Initial reactions when learning about cultured meat were underpinned by feelings of disgust and considerations of unnaturalness. Consumers saw few direct personal benefits but they were more open to perceiving global societal benefits relating to the environment and global food security. Both personal and societal risks were framed in terms of uncertainties about safety and health, and possible adverse societal consequences dealing with loss of farming and eating traditions and rural livelihoods. Further reflection pertained to skepticism about 'the inevitable' scientific progress, concern about risk governance and control, and need for regulation and proper labeling.

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REVIEW

Challenges and prospects for consumer acceptance of cultured meat

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Abstract

Consumer acceptance of cultured meat is expected to depend on a wide diversity of determinants ranging from technology-related perceptions to product-specific expectations, and including wider contextual factors like media coverage, public involvement, and trust in science, policy and society. This paper discusses the case of cultured meat against this multitude of possible determinants shaping future consumer acceptance or rejection. The paper also presents insights from a primary exploratory study performed in April 2013 with consumers from Flanders (Belgium) ($n=180$). The concept of cultured meat was only known (unaided) by 13% of the study participants. After receiving basic information about what cultured meat is, participants expressed favorable expectations about the concept. Only 9% rejected the idea of trying cultured meat, while two thirds hesitated and about quarter indicated to be willing to try it. The provision of additional information about the environmental benefits of cultured meat compared to traditional meat resulted in 43% of the participants indicating to be willing to try this novel food, while another 51% indicated to be 'maybe' willing to do so. Price and sensory expectations emerged as major obstacles. Consumers eating mostly vegetarian meals were less convinced that cultured meat might be healthy, suggesting that vegetarians may not be the ideal primary target group for this novel meat substitute. Although exploratory rather than conclusive, the findings generally underscore doubts among consumers about trying this product when it would become available, and therefore also the challenge for cultured meat to mimic traditional meat in terms of sensory quality at an affordable price in order to become acceptable for future consumers.

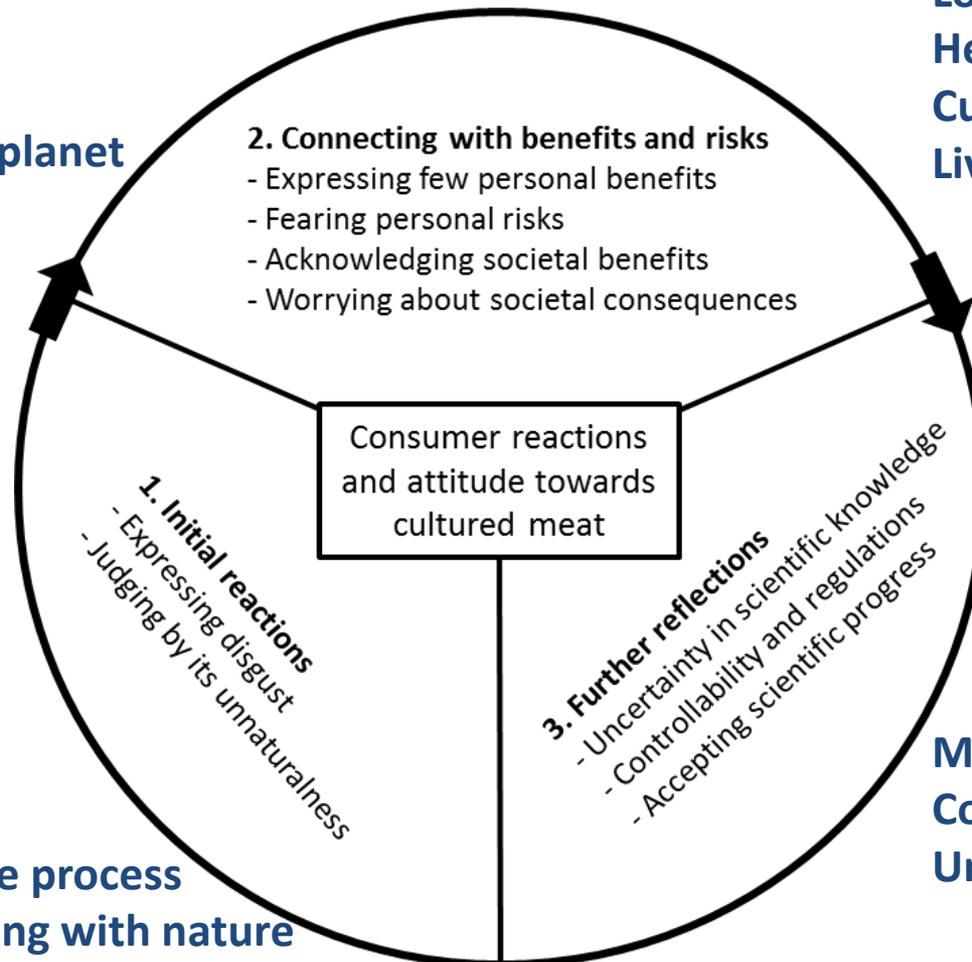
Keywords: acceptance, artificial, attitude, consumer, cultured, *in vitro*, meat, synthetic

Consumer reactions

(Focus group discussions , n=109, and online deliberation, n=70, in Belgium, Portugal and the UK)

Curiosity
Ethical motives
Food security
Not as a nation, as a planet

Long-term impact
Health implications
Cultural practices
Livestock and farms



First exposure
Emotional reactions
Unnaturalness of the process
Playing God – Messing with nature

Mutations, Defects
Controls
Unavoidable progress

Consumer awareness and expectations (n=180, April 2013)

Very low awareness

Surprisingly favourable perception, except on taste and price

Table 2 Awareness (%) and expectations about cultured meat (7-point semantic differential scale) and evaluation of *in vitro* meat as an alternative for traditionally produced meat (1=Totally disagree, 7=Totally agree) (n=180)

Awareness about cultured meat: "Have you heard about <i>in vitro</i> meat?"	%	
Yes, and I know what it means	13.0	
Yes, but I do not know what it means	36.0	
No, I have never heard of <i>in vitro</i> meat	51.0	
Expectations about cultured meat	Mean	SD
Not healthy (1)–very healthy (7)	3.98	0.92
Not safe (1)–very safe (7)	4.64	1.24
Not nutritious (1)–very nutritious (7)	4.59	1.13
Not ecological (1)–very ecological (7)	4.91	1.26
Not ethical (1)–very ethical (7)	4.73	1.62
Much more expensive (1)–much cheaper than traditional meat (7)	3.31	1.52
Much less tasty (1)–much tastier than traditional meat (7)	3.38	0.90
Much less sustainable (1)–much more sustainable than traditional meat (7)	5.12	1.28
"I believe <i>in vitro</i> meat as a substitute for traditional meat is ..."	Mean	SD
Good	4.61	1.41
Feasible	4.35	1.43
Acceptable	4.58	1.44
Effective	4.53	1.41
A long term solution	4.84	1.63

Willingness to accept

Importance of the story told

Table 3 Frequency (% , $n=180$) of participants claiming to be 'not', 'maybe' and 'surely' willing to try, purchase and pay a price premium for cultured meat

	Basic information about technology ¹⁾			Additional information about benefits ²⁾		
	Not	Maybe	Surely	Not	Maybe	Surely
Willing to try	9.4	66.7	23.9	6.1	51.4	42.5
Willing to purchase	11.7	68.9	19.4	5.6	58.1	36.3
Willing to pay more	42.2	43.9	13.9	36.3	27.9	35.8

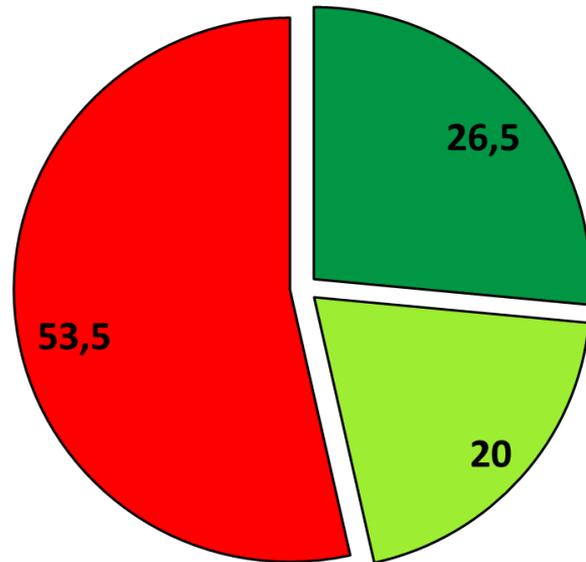
¹⁾ Basic information: “*In vitro* meat, which is also called ‘cultured meat’, is meat produced in a laboratory using stem cells from an animal and a suitable growth medium. This way, it may be possible to cultivate basically one million ton of meat muscle tissue by using stem cells from one animal. This could be an alternative to traditional meat as we know it nowadays. The product should not be confused with meat substitutes like tofu or quorn because it is real meat, only it has not been obtained as part of a living animal.” This basic information was combined with the visual flowchart “How it works” based on Daily Mail (2012).

²⁾ Additional information: “Currently about one-third of Earth’s land area is agricultural land. About two-thirds of this agricultural land is used for cultivating livestock, which is responsible for about 18% of the greenhouse gas (GHG) emissions. This is more than the transportation sector. The environmental problems associated with livestock production could partially be reduced by no longer producing meat in the traditional way but instead produce meat *in vitro*. This could lead to a 96% reduction of GHG emissions compared to traditional meat. By culturing meat in a lab, one could also prevent diseases such as mad cow disease and microbiological infections, such as *Salmonella*. Also the fat composition of the meat can be improved, for example by enriching the meat with omega-3 fatty acids.” Note that this information message explicitly points at the environmental burden of traditional livestock production, while it is univocally positive about culturing meat and stressing possible benefits only.

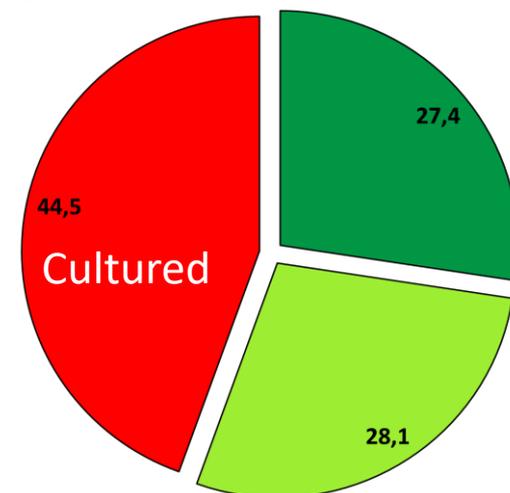
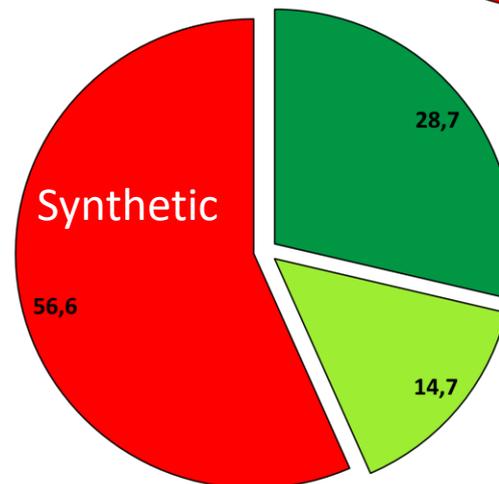
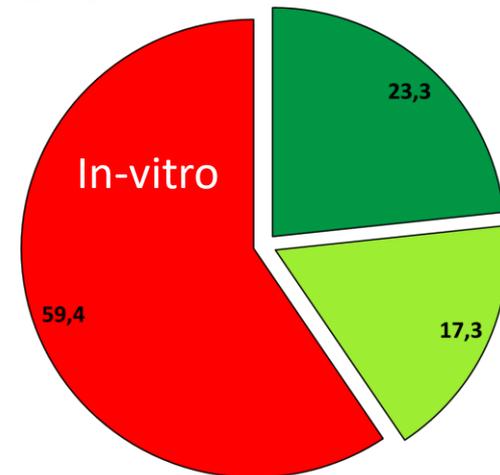
- Data collection **December 2013**, Flanders, Belgium
- n = 404
- 5% vegetarians
- 39% men; 61% women
- Age 18-79 years; average age 42 years
- Representative for age and region (5 provinces of Flanders)
- 24% with daily meat consumption; 67% several-times-a-week
- 17% planned to reduce meat consumption

Public awareness

Awareness **overall**, and depending on exposure to [in-vitro, synthetic, or cultured] meat, n=404

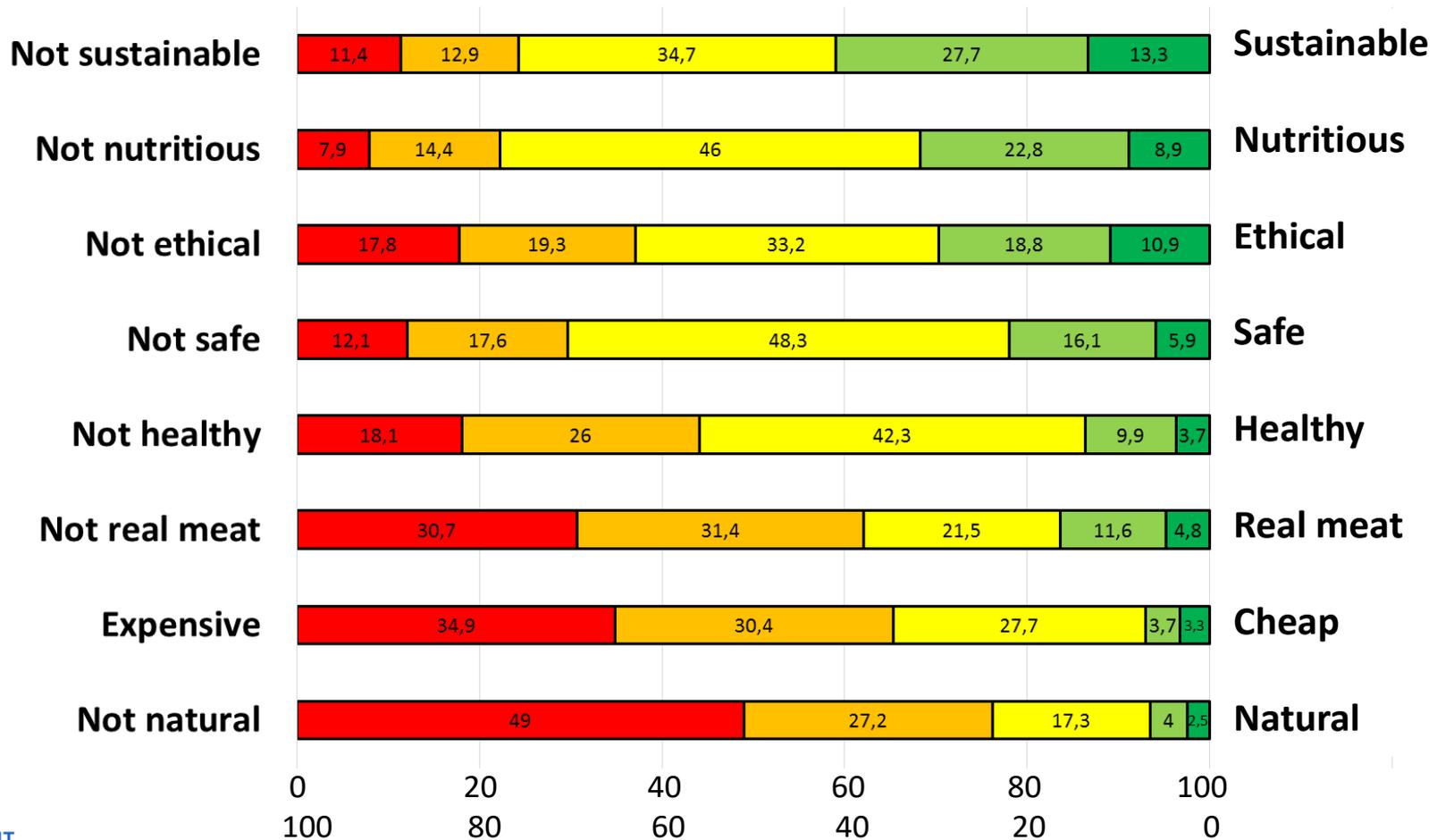


- Yes, and know what it is
- Yes, but don't really know
- No, never heard of



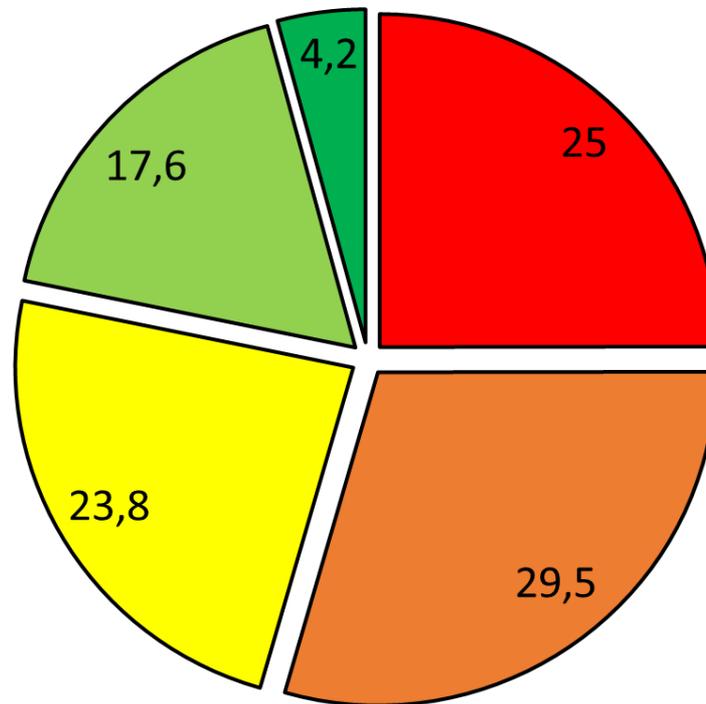
Attribute perception

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



Willingness-to-accept

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



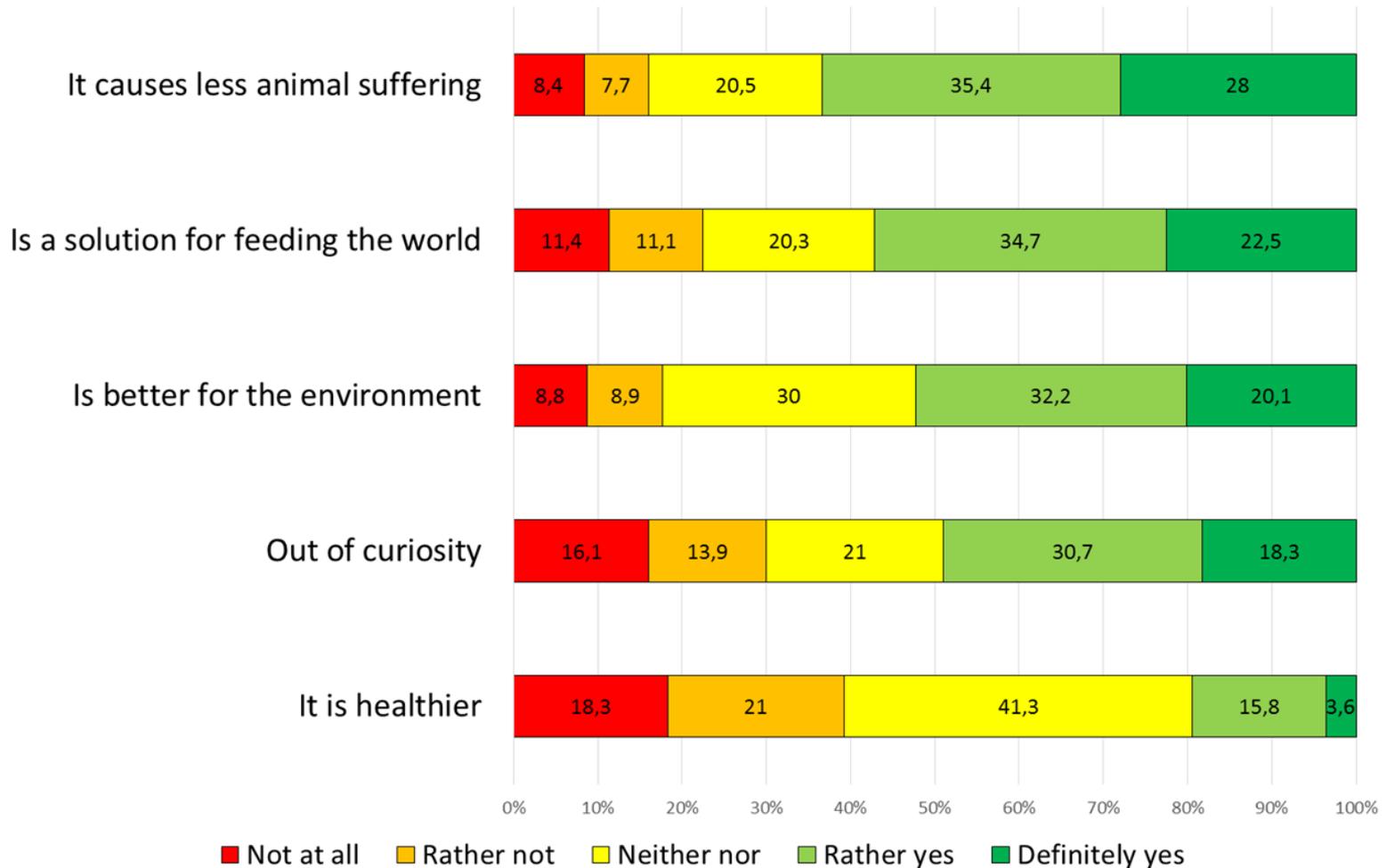
■ Not at all
■ Rather yes

■ Rather not
■ Definitely yes

■ Neutral

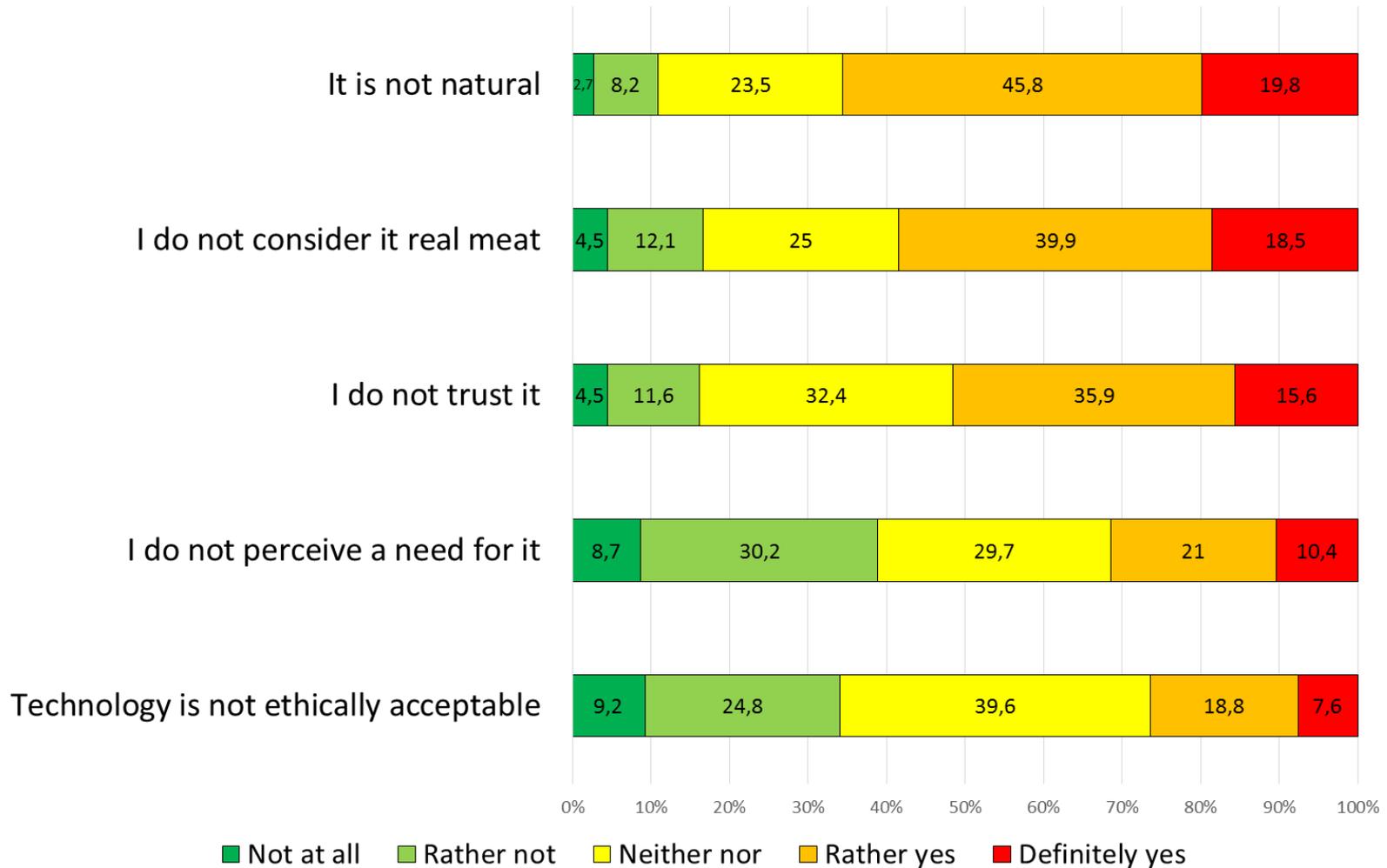
Motives

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



Barriers

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



Determinants of willingness-to-accept

Binary logistic regression modelling

Accepters (21.2%) vs. Doubters/Rejecters (78.8%), n=397

	B	S.E.	Wald	p	Exp(B)
Gender (Male)	1.64	0.43	14.46	<0.001	5.15
Age	-0.032	0.01	6.65	0.010	0.97
Barriers	-2.73	0.35	60.93	<0.001	0.07
Motives	1.98	0.36	30.10	<0.001	7.23
Constant	0.87	1.39	0.39	0.531	

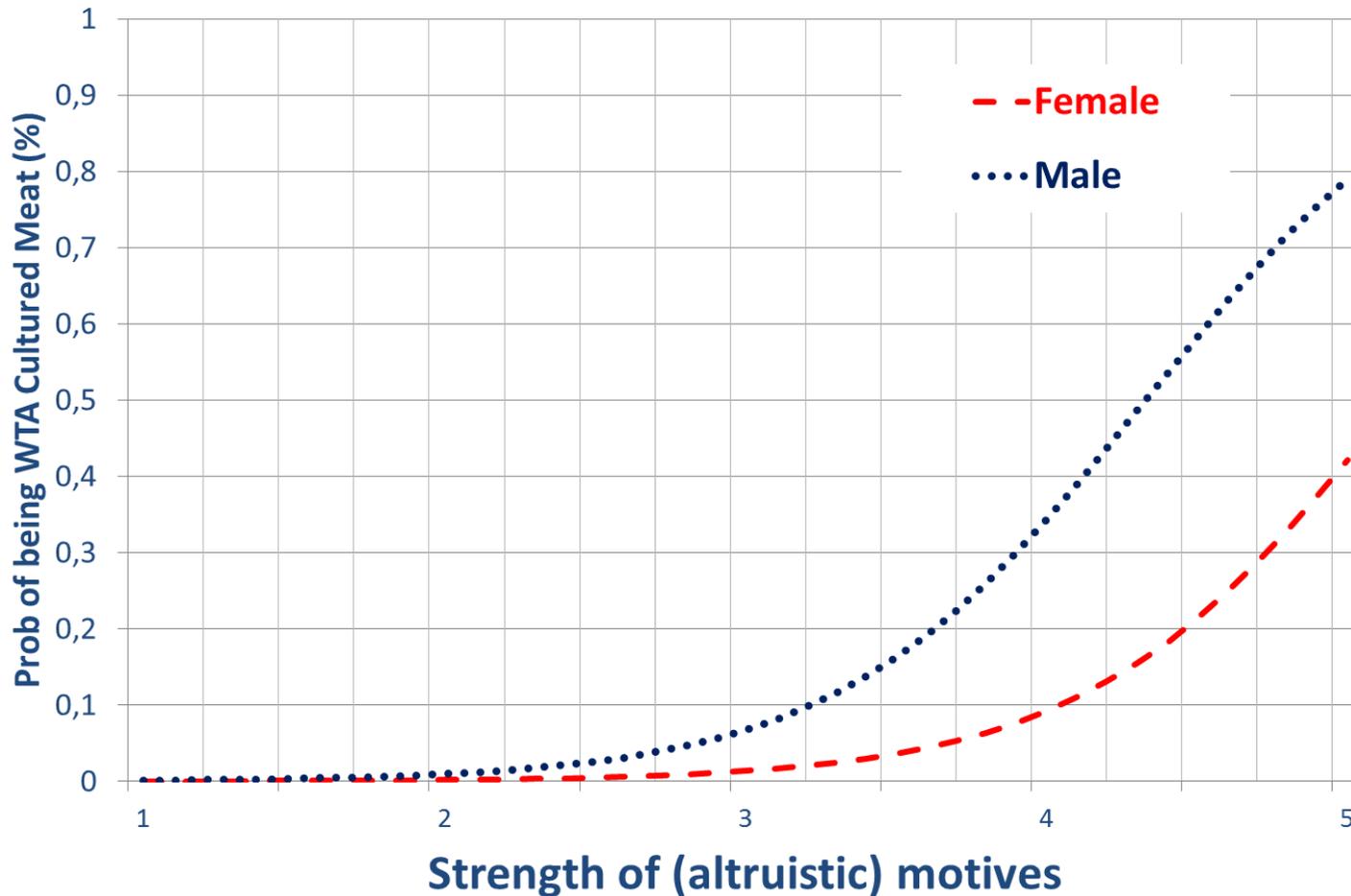
Nagelkerke $R^2=0.67$; Correct predictions = 91.7%

The likelihood of being willing to eat cultured meat

- Is 5 times bigger among males compared to females
- Decreases with 30% per 10 years age increase
- Decreases 14-fold per unit on the scale of Barriers
- Increases 7-fold per unit on the scale of Motives

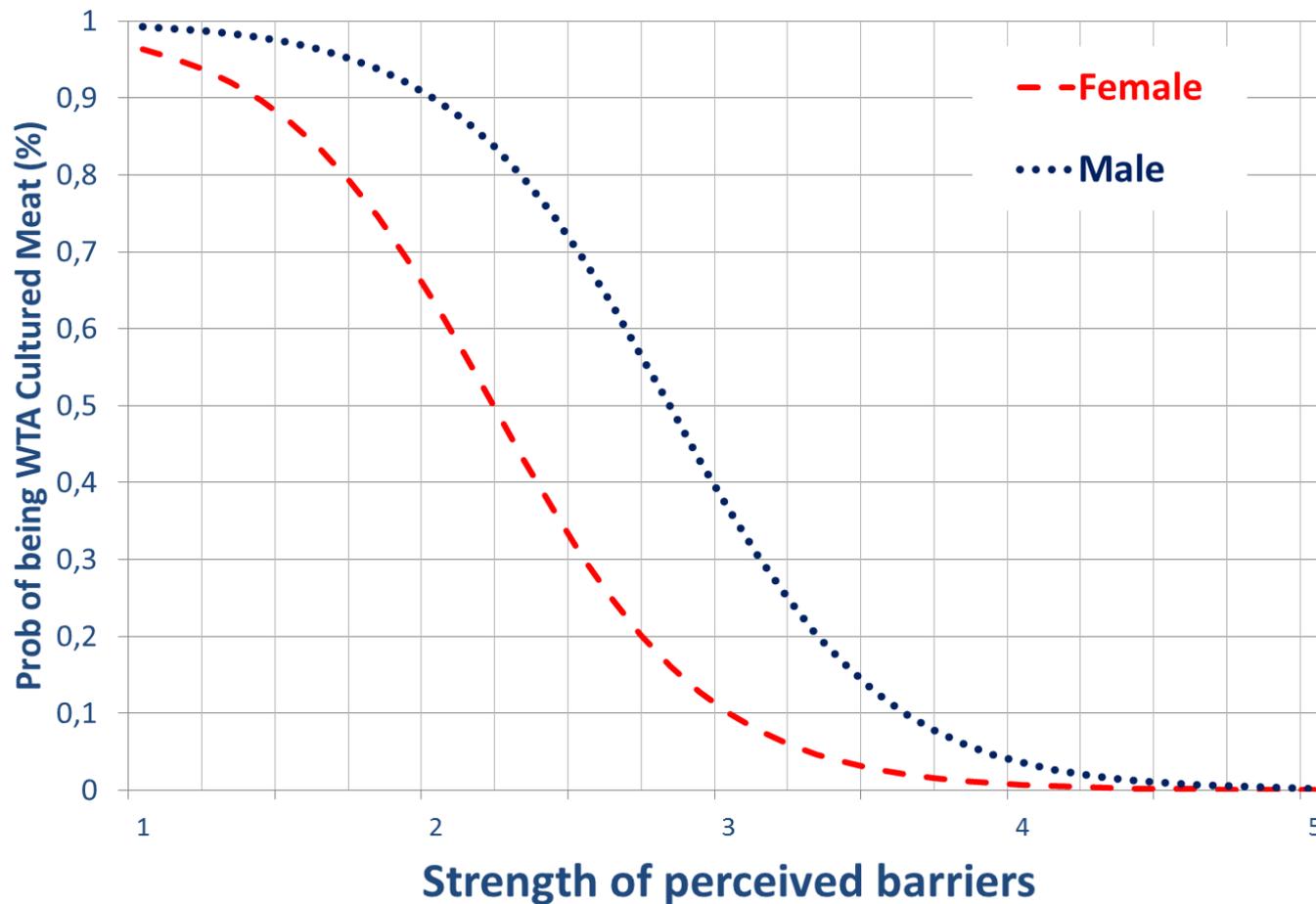
Probability of accepting cultured meat

Simulation depending on strength of motives (animal welfare, environment, feeding the world)



Probability of accepting cultured meat

Simulation depending on
strength of barrier perception (not natural, not real meat, no trust)



Conclusions

- Ever increasing consumer expectations about food
- Important areas of change in consumer behavior
- Multitude of potential issues of concern related to food
- “Meat” more than average involved and affected

- Perceived match health-sustainability, in favour of plant-based
- Insects as food: hype is largely over; may return some time
- Insects as feed: great potential, esp. seafood and poultry
- Cultured meat: strong promises still to be substantiated
- Others: algae, microalgae, Rubisco, microbial protein, ...

Bridging Science and the Consumer

Teagasc Food Research Centre

Dublin, 19th November 2019

**Consumer food choice behavior: underlying preferences,
motivations and attitudes**

with a focus on alternative proteins

THANKS FOR YOUR ATTENTION

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