Can In Vitro Meat Be a Viable and Sustainable Alternative to Conventional Meat in the Future?

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INTRODUCTION

Conventional meat production raises environmental, animal-welfare, and ethical concerns and therefore increases the interest in the development of in-vitro meat (IVM) as a potential alternative (Böhm et al., 2017) which is meat produced by cultivating animal cells into large cells populations that eventually develop into whole muscle tissues. Research has evaluated consumer attitudes to IVM acceptance such as price concerns, income and other demographics, and recent advances in bioengineered scaffolds have explored ways to improve IVM production (Wilks and Phillips, 2017; Singh et al., 2023). The hypothesis of this study is that adults' willingness to purchase and consume IVM will significantly differ by age group (18-29, 30-44, 45-59, 60+), meat price compared to conventional meat * (25% less/$6.75, 10% less/$8.10, same price/$9, 25% more/$11.25, 50% more/$13.50), and the amount of information provided about potential IVM advantages and disadvantages.

* $9 per lb of conventional ground beef

MATERIALS & METHODS

For this experimental study, people were surveyed using Google Forms. A total of 120 participants were recruited and divided into four age groups (18-29, 30-44, 45-59, 60+). Each age group consisted of 30 participants who were assigned to either the control or test group. Participants in the control group received a short definition of IVM, whereas participants in the test group received the same definition but additionally a neutral in-depth explanation of potential benefits and disadvantages which included aspects of animal wellbeing, energy and environmental requirements, production cost and also uncertainties of mass production. Subsequently, all participants answered the same questions. The questions consisted of age, rating their willingness to consume IVM, and purchasing IVM under different price levels as well as indicating whether they think IVM would contribute to more sustainable food consumption or not, and stating their primary reason for their willingness or unwillingness to consume IVM. Answers were then analyzed using Microsoft Excel to conduct a two-way factorial regression analysis to examine differences in the effect of the experimental condition across the different age groups.

FIGURES

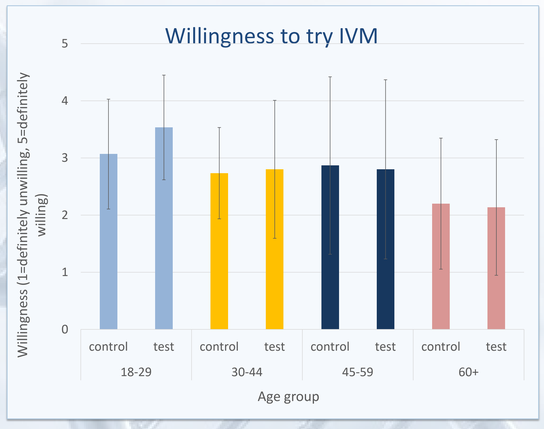


Figure 1. Willingness to try IVM based on the information provided for control and test group for ages 18-29, 30-44, 45-49 and 60+ on a scale of 1 (definitely unwilling) to 5 (definitely willing) (mean and SD)

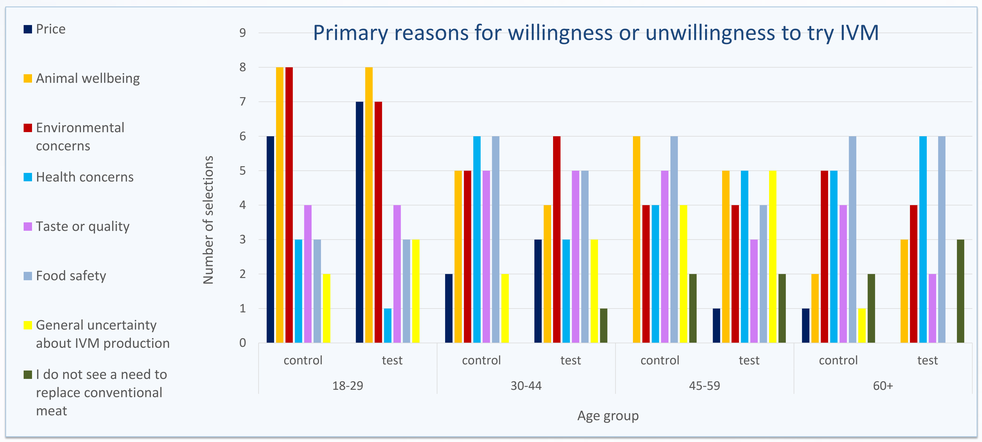


Figure 2. Primary reasons for willingness or unwillingness to try IVM based on the information provided for control and test group ages 18-29, 30-44, 45-49 and 60+, with multiple selections allowed.

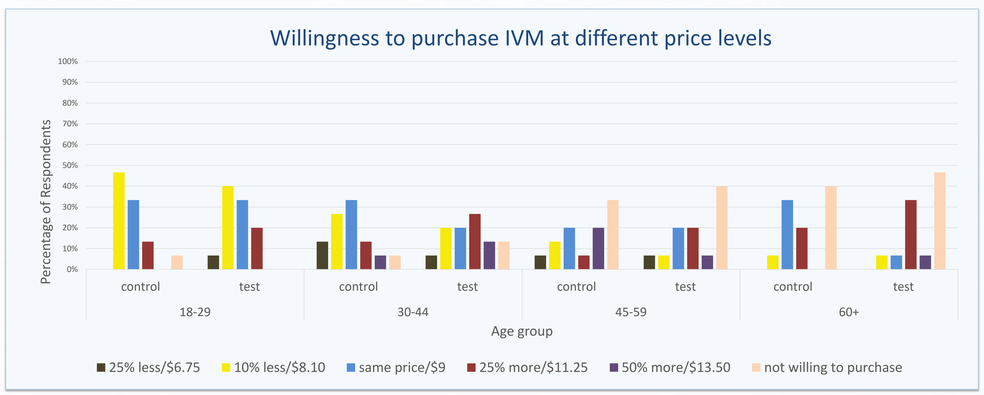


Figure 3. Willingness to purchase IVM at different price levels compared to $9 per lb of conventional ground beef (25%less/$6.75, 10%less/$8.10, same price/$9, 25% more/$11.25, 50% more/$13.50) for control and test group ages 18-29, 30-44, 45-59 and 60+.

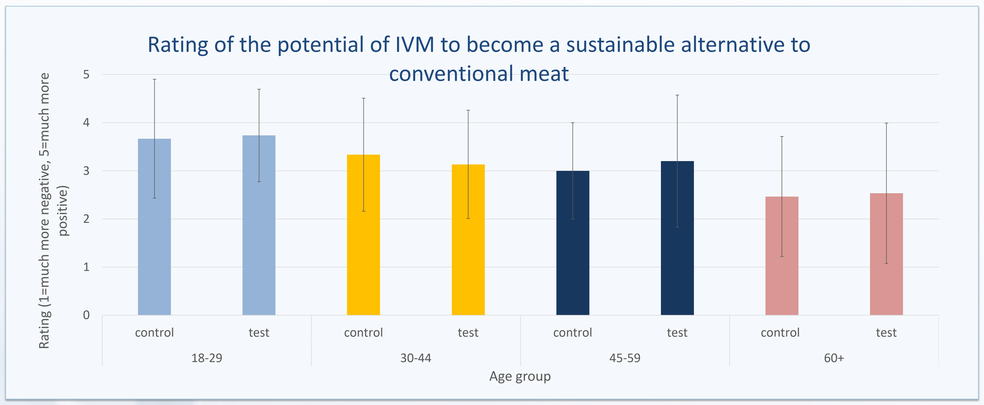


Figure 4. Rating of the potential of IVM to become a sustainable alternative to conventional meat for control and test group ages 18-29, 30-44, 45-59 and 60+ on a scale of 1 (definitely unwilling) to 5 (definitely willing) (mean and SD)

RESULTS

For Figure 1, the participants' willingness to try IVM across age groups and experimental conditions shows the following results:

- Both 18-29 age groups show the highest mean values compared to all other age groups
- 60+ age groups show the lowest mean values compared to all other groups
- The two-way factorial analysis shows that the model is statistically significant ($F(7,112)=2.12$, p-value=0.047, and $R^2=0.117$, with the 60+ age group showing lower willingness to try IVM compared to the 18-29 age group
- The experimental condition of the control and test group was not statistically significant (p-value=0.288)

For Figure 2, the participants' primary reason for willingness or unwillingness to try IVM across age groups and experimental conditions shows the following results:

- 18-29 group: highest number of selections for animal wellbeing and environmental concerns within the group and compared to other age groups. The test group has the highest number of selections for price compared to the control and all other groups
- 30-44: highest number of selections for health concerns and food safety in the control group
- 45-59: highest number of selections for animal wellbeing and food safety in the control group
- 60+: highest number of selections for health concerns and food safety in the test group

For Figure 3, the participants' willingness to purchase IVM at different price levels shows that the percentage of respondents who are willing to purchase IVM for 25% less is the highest for the 30-44 control group. The willingness to purchase IVM for 10% less decreases from the age group 18-29 to 60+. Also significant is that the unwillingness to purchase IVM at all increases starting from the 30-44 age group to 60+.

For Figure 4, the participants' rating of the potential of IVM to become a sustainable alternative to conventional meat shows the following results:

- The mean ratings are the highest for age groups 18-29 and decrease to the 60+ age groups which show the lowest mean ratings
- The two-way factorial analysis shows that the model is statistically significant ($F(7,112)=2.22$, p-value=0.037, $R^2=0.122$, with the age group 60+ rating IVM's potential significantly lower than the 18-29 age group (b=-1.20, p-value=0.008)
- The experimental condition of the control and test group (p-value = 0.880) was not statistically relevant

DISCUSSION

The results partially support the hypothesis. The amount of information provided to the control and test groups did not significantly influence willingness to try IVM, perceptions of IVM as a sustainable future alternative, or price-related consumer choices. However, age-related differences were observed. Overall, the results of this study suggest that age-related differences influence consumer acceptance of IVM. Younger participants in the 18- 29 age group may be more willing to try IVM due to increased concern for environmental and animal well-being. Other research is partially consistent with these findings by identifying demographic characteristics as factors in IVM acceptance (Wilks and Philips, 2017). While the results of this study suggest that age influences IVM acceptance significantly, it is important to consider demographic and geographic differences when analyzing IVM consumer preferences and the findings of this study cannot be generalized to consumers worldwide. Future research should evaluate consumer attitudes by considering not only individuals but also larger regions and cultural backgrounds to better understand the potential of global IVM adoption.

LITERATURE CITED

The resultsBöhm, I., Ferrari, A., & Woll, S. (2017). In-vitro-Fleisch : Eine technische Vision zur Lösung der Probleme der heutigen Fleischproduktion und des Fleischkonsums? Kit.Edu. https://doi.org/10.5445/IR/1000076735

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Wilks, M., & Phillips, C. J. C. (2017). Attitudes to in vitro meat: A survey of potential consumers in the United States. PLoS ONE, 12(2), e0171904. http://dx.doi.org/10.1371/journal.pone.0171904

Scan to view the control group survey

Scan to view the test group survey