

Cereal versus Pulses: what category of ingredients drives the consumption of veggie proteins?

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Abstract

Given the need to reduce meat consumption for both environmental and health reasons, alternative proteins such as plant-based meat alternatives (PBMA) are emerging as more sustainable and health-conscious options. However, consumers are skeptical regarding the environmental impact and health benefits of PBMA, often due to their complex ingredient lists. This research explores how the emphasis on different ingredients (pulses vs. cereals) in PBMA influences consumer perceptions and purchase intentions. Three studies tested how ingredient type and visual representation (raw vs. cooked) impact PBMA evaluation. Study 1 found that burgers made from pulses (e.g., lentils) were perceived as healthier and more environmentally friendly than cereal-based alternatives, increasing purchase intention. Study 2 extended this by testing a broader range of pulses and cereals, confirming that pulses were seen as healthier, with indirect effects on purchase intention. Study 3 focused on pulses and revealed that cooked pulses were viewed more favorably than raw ones, particularly in terms of tastiness and environmental friendliness. These results reinforce the importance of ingredient choice and presentation in influencing consumer attitudes towards PBMA, with implications for marketers and for sustainability initiatives in public policy.

Keywords: alternative proteins, consumer perceptions, purchase intention, ingredients, front-of-package

Résumé

Compte tenu de la nécessité de réduire la consommation de viande pour des raisons environnementales et sanitaires, les protéines alternatives telles que les substituts de viande à base végétale (PBMA) apparaissent comme des options plus durables et plus saines de la santé. Cependant, les consommateurs sont sceptiques quant à l'impact environnemental et aux bienfaits pour la santé des PBMA, souvent en raison de la complexité de composition. Cette recherche explore comment la mise en avant des ingrédients (légumineuses vs céréales) dans les PBMA influence les perceptions des consommateurs et leurs intentions d'achat. Trois études ont testé l'impact du type d'ingrédients et de leur représentation visuelle (crus vs cuits) sur l'évaluation des PBMA. L'étude 1 a révélé que les hamburgers à base de légumineuses (par exemple, des lentilles) étaient perçus comme plus sains et plus respectueux de l'environnement que les substituts à base de céréales, ce qui augmente l'intention d'achat. L'étude 2 a prolongé cette recherche en testant une gamme plus large de légumineuses et de céréales, confirmant que les légumineuses étaient considérées comme plus saines, avec des effets indirects sur l'intention d'achat. L'étude 3 s'est concentrée sur les légumineuses et a révélé que les légumineuses cuites étaient perçues plus favorablement que les légumineuses crues, notamment en termes de saveur et de respect de l'environnement. Ces résultats renforcent l'importance du choix et de la présentation des ingrédients dans l'influence des attitudes des consommateurs à l'égard des PBMA, avec des implications pour les spécialistes du marketing et pour les initiatives de durabilité dans les politiques publiques.

Mots-clés: protéines alternatives, perceptions des consommateurs, intention d'achat, ingrédients, face avant de l'emballage

Introduction and research objectives

By 2050, the global population is expected to exceed 10 billion, driving a 70% increase in meat production (Choudhury et al., 2020). However, conventional meat production significantly increases greenhouse gas emissions, water scarcity (Kyriakopolou et al., 2019), and cardiovascular diseases (González et al., 2020). For both environmental and health reasons, shifting to protein alternatives and reducing meat consumption is essential. Since taste and enjoyment are barriers to reducing meat consumption (Poquet et al., 2017), Plant-Based Meat alternatives (PBMA)s—typically made of pulses, seeds and oilseeds—aim to mimic meat's taste, texture, flavor, and appearance (Bryant, 2022; Gastaldello et al., 2022). However, compared to meat, PBMA)s have longer ingredient lists, raising skepticism about their environmental impact and health benefits (El Sadig & Wu, 2024; Hartmann et al., 2022), as they are often perceived as highly processed and not natural (Varela et al., 2022). At the same time, consumers tend to underestimate their calorie content due to a health halo effect of PBMA)s (Gonzales et al., 2023).

The complexity of PBMA)s in terms of nutrients and ingredients leads consumers to infer judgments primarily on packaging (Hagen, 2021; Krishna, Cian and Aydınoğlu 2017; Orth & Malkewitz, 2008). The choice of the elements to put forward in the packaging of PBMA)s is very important since these cues can attract attention to the brand (Clement et al., 2013), communicate brand-related values (Khan et al., 2022) and product perceptions, such as healthiness (Bou-Mitri et al., 2021), tastiness (Schnurr, 2019; Mai et al., 2016), environmental friendliness (Magnier et al., 2016; Steenis et al., 2017; Sokolova et al., 2023), sensory qualities (Shifferstein et al., 2022), and overall quality (van Ooijen et al., 2017). Ingredients depicted on packaging can activate mental imagery about the product, such that it appears more pleasant, innovative, healthier, and tastier (Madzharov and Block, 2010; Thomas and Capelli, 2023). PBMA)s typically consist of 50-80% water, 10-25% textured vegetal protein (e.g. soy), 4-20% non-textured proteins (e.g. wheat, soy, pea, potato, rice and/or lupin protein concentrates and isolates), along with flavors, fats, binding agents, and colorants (El Sadig & Wu, 2024). A key question in positioning PBMA)s is which ingredients to emphasize. Research on the perception of vegetarian protein sources suggests that pulses are generally disliked, associated with side dishes rather than protein sources, and perceived as food primarily for vegetarians (Melendez-Ruiz et al., 2019). Given these negative associations, this research investigates how emphasizing different PBMA) ingredients—pulses versus cereals—on packaging influences product perception and purchase intention. Across three studies, we demonstrate that highlighting pulses over cereals in a veggie burger enhances purchase intention by increasing perceived healthiness. Moreover, when visually representing pulses in a veggie burger, a cooked depiction is more effective than a raw one, as it strengthens perceptions of tastiness and environmental friendliness.

Overview of the studies

Study 1 tests how type of ingredient in a burger (pulses [i.e., lentils] vs. cereal [i.e., wheat] vs. meat [control]) influences purchase intention and product evaluation. Study 2 further examines the impact of ingredient type (pulses vs. cereals vs. veggie with no ingredient [control]) while analyzing different options. Participants were presented with five different pulse options (lentils, chickpeas, soybeans, black kidney beans, and red kidney beans) and five cereal options (wheat, rice, quinoa, oats, and bulgur). These were then compared to a veggie condition without specific ingredient information. Study 3 focuses only on pulses and investigates how different pictorial representations of the ingredient (raw vs. cooked) influences consumers' perceptions.

Study 1

Study 1 tests if consumers' judgments of vegetarian proteins change depending on its main ingredient: pulses or cereals. Most vegetarian protein sources contain a mix of products, and companies can choose to highlight one main ingredient, such as pulses (e.g., lentils, beans) or cereals (e.g., quinoa, corn). We specifically investigate consumers' reactions to pulses or cereals as the main ingredient highlighted in vegetarian protein sources.

Participants and procedures

In exchange for a monetary reward, 598 Prolific workers ($M_{\text{age}} = 37.9$, 63.5% Female) living in the US completed this study. Participants were asked to imagine shopping in a grocery store and were randomly assigned to either see a veggie burger with the information "*this veggie burger is made of lentils*", or "*this veggie burger is made of wheat*", or to the control condition, a traditional *meat burger* (see figure 1). Participants next indicated their intention to purchase the product (i.e., How likely would you purchase this burger? very unlikely-very likely) and evaluated it in multiple attributes, including healthiness (e.g., This burger is not healthy-very healthy), environmental friendliness (e.g., How environmentally friendly or green is this burger? not at all-extremely), filling (e.g., This burger is not filling-very filling), and tastiness (This burger is not tasty-very tasty). Finally, we measured demographics.

-----insert here Figure 1-----

Results and Discussion

A one-way ANOVA including the burger type (made with lentils vs. made with wheat vs. control—meat burger) as independent factor predicting participants intentions to purchase the burger shows a significant main effect ($F(2,595) = 3.44$, $p = .033$). Participants were more likely to buy the veggie burger when it was made of lentils ($M = 3.77$) than wheat ($M = 3.26$, $p = .009$). We found no difference on purchase intention when comparing the lentils and the control burger ($M_{\text{meat}} = 3.52$; $p = .180$) nor between the control and the wheat ($p = .205$).

Burger type influenced perceptions of healthiness ($F(2,595) = 55.41$, $p < .001$). Both the lentils and the wheat burger ($M_{\text{lentils}} = 5.11$, $p < .001$; $M_{\text{wheat}} = 4.53$, $p < .001$) were considered healthier than control ($M_{\text{meat}} = 3.75$). The lentils burger was considered healthier than the wheat burger ($p < .001$).

Burger type also influenced perceptions of environmental friendliness ($F(2,595) = 69.84$, $p < .001$). Both the lentils and the wheat burger ($M_{\text{lentils}} = 4.63$, $p < .001$; $M_{\text{wheat}} = 4.44$, $p < .001$) were considered more environmentally friendly than control ($M_{\text{meat}} = 3.95$). There were no difference in environmental friendliness between the lentils and the wheat burger ($p = .185$).

Burger type affected perceptions of how filling the burger is ($F(2,595) = 7.36$, $p < .001$). The wheat burger ($M = 4.35$) was perceived as less filling than both the lentils burger ($M = 4.82$, $p < .001$) and the control ($M_{\text{meat}} = 4.74$, $p = .003$), and. We found not difference on filling judgments between the lentils' burger and control ($p = .531$).

Finally, burger type influences tastiness perceptions ($F(2,595) = 7.39$, $p < .001$). The wheat burger ($M = 3.75$) was perceived as less tasty than both the lentils burger ($M = 5.11$, $p < .001$) and the control ($M_{\text{meat}} = 4.53$, $p < .001$). The lentils burger was considered tastier than the meat burger ($p < .001$).

We ran a parallel mediation analysis (Process Model 4, Hayes 2018), including the type of burger as independent factor (lentils as the reference category), all burger perceptions as mediators (i.e., healthiness, environmental friendliness, filling, and tastiness), predicting purchase intention. When contrasting the lentils with the wheat burger, results show a significant mediation through tastiness and filling perceptions. Specifically, wheat decreased taste perceptions, which consequently decreased purchase intention ($ab = -.2973$, $CI_{95\%}: -.5282; -.0861$). Participants in the wheat condition judged the product as less filling, what decreased purchase intentions ($ab = -.0951$, $CI_{95\%}: -.1881; -.0287$). When contrasting the lentils with the

meat (control) burger, results show a significant mediation through environmental friendliness ($ab = -.2893$, $CI_{95\%}: -.4618; -.1225$). Participants judged the lentils burger as more environmentally friendly, what increased purchase intentions. When contrasting the wheat with the meat (control) burger, we found that the wheat burger was judged as less tasty, which decreased purchase intention ($ab = -.3987$, $CI_{95\%}: -.6255; -.1812$), as less filling, which decreased purchase intention ($ab = -.0743$, $CI_{95\%}: -.1605; -.0148$), but as more environmentally friendly, which increased purchase intention ($ab = .2481$, $CI_{95\%}: .1057; .4094$).

Study 1 demonstrates that consumers prefer pulses over cereals in PBMA. Specifically, the cereal-based option was perceived as less tasty and less filling than the pulse-based option. While ingredient type did not directly influence purchase intention, mediation analyses revealed that the perceived environmental friendliness of the pulse-based burger positively impacted purchase intention. These findings highlight the advantage of pulses over cereals, a result we aim to replicate in Study 2 through a broader comparison of various pulse and cereal types.

Study 2

While Study 1 examined the effect of highlighting pulses or cereals as the main ingredient in a PBMA, it focused only on two specific ingredients: lentils and wheat. Study 2 takes a broader approach by assessing perceptions of five different pulses (lentils, chickpeas, soybeans, black kidney beans, and red kidney beans) and five different cereals (wheat, rice, quinoa, oats, and bulgur), while also including a control condition with no ingredient information (i.e., a generic veggie burger) to compare the impact of ingredient labeling.

Participants and Procedure

In exchange for a monetary reward, 1126 Prolific workers ($M_{age} = 39.1$, 54% Female) living in the US participated in this one-factor 11-level between subjects' design study. Participants were asked to imagine being in a grocery store and were randomly assigned to see one out of eleven types of veggie burgers. Participants evaluated a veggie burger in one of eleven conditions: five featuring different pulses (lentils, chickpeas, soybeans, black kidney beans, red kidney beans), five featuring different cereals (wheat, rice, quinoa, oats, bulgur), and one with no ingredient description (see Figure 2). As the main goal of this research is to compare reactions to pulses and cereals, the five pulses conditions were merged for the analyses, and the same was done for the cereal conditions. After looking at the product, participants reported purchase intentions, product perceptions (i.e., healthiness, environmental friendliness, tastiness, and filling perceptions), and demographics.

-----insert here Figure 2-----

Results and Discussion

A one-way ANOVA, including the three burger ingredients information (control vs. pulses vs. cereal) predicting purchase intention showed no significant main effect ($F(2,1119) = .745$, $p = .475$). Multiple ANOVAs predicting each product perception showed no effect of the ingredients information (control vs. pulses vs. cereal) on environmental friendliness ($F(2,1119) = .908$, $p = .404$), filling perceptions ($F(2,1119) = 1.247$, $p = .288$), nor on tastiness ($F(2,1119) = .702$, $p = .496$). We did find a significant effect of condition on perceptions of healthiness ($F(2,1119) = 3.377$, $p = .035$), with participants judging the pulses condition ($M = 5.11$) as healthier than the cereal condition ($M = 4.90$, $p = .015$), but not healthier than control ($M = 4.88$, $p = .117$). We found no difference between the cereal condition and control ($p = .875$).

To test the effect of healthiness perceptions on purchase intention we ran a parallel mediation analysis (Process Model 4, Hayes 2018), including the ingredients information as independent factor (pulses as the reference category), healthiness perceptions as mediator, predicting purchase intention. We found a significant mediation when comparing the pulses

condition with the cereal condition ($ab = .1477$, $CI_{95\%}: -.2682; -.0270$). We found no mediation when comparing the lentils condition with the control condition ($ab = -.1659$, $CI_{95\%}: -.3857; .0383$). When contrasting the control with the cereals condition (control as the reference category) result show no support for the healthiness mediation ($ab = .0182$, $CI_{95\%}: -.1951; .2258$).

These results provide further support that highlighting pulses as the main ingredient for PBMA's remains the most interesting positioning strategy. While there were no direct effects of condition on purchase intentions, there was a significant indirect effect through healthiness perceptions leading to increased purchase intentions for pulses in comparison to cereals.

Study 3

Study 3 focuses on pulses only and tests whether showing a pictorial presentation of the product (raw vs. cooked) influences consumers' perceptions (see Figure 3). Specifically, we explore whether depicting part of the product with ingredients in their raw form, as is often done by PBMA's brands, affects consumer judgments (e.g., healthiness and tastiness). Building on the findings from Studies 1 and 2, which demonstrated the superiority of pulses over cereals, this study focuses solely on pulses (raw vs. cooked) and compares them to a control product (meat), also presented in its raw or cooked state.

-----Insert here Figure 3 -----

Participants and procedures

In exchange for a monetary reward, 767 prolific workers ($M_{age} = 43.7$, 57% Female) living in the US completed this study. Participants were required to imagine shopping in a grocery store and were randomly assigned to one out of four conditions: pulses' burger with raw ingredient, vs. pulses' burger with cooked ingredient, vs. meat burger with raw ingredient, vs. meat burger with cooked ingredient. Participants who saw the pulses' burgers, the package included the information *Veggie burger "made with kidney beans"*, while participants in the control burger saw the information *Meat Burger "made with beef"*. Participants either saw the burger entirely cooked, or half cooked-half pictured with raw beans or meat. Next, we measured purchase intentions, product's perceptions, and demographics (e.g., age, gender).

Results and Discussion

A one-way ANOVA with burger condition predicting purchase intention shows a significant effect ($F(3,763) = 14.43$, $p < .001$). Participants reported a higher intention to purchase the pulses burger in its cooked ($M = 3.56$) version in comparison to its raw presentation ($M = 2.89$, $p = .001$), and in comparison to the raw meat presentation ($M = 3.10$, $p = .025$), but lower intentions in comparison to the cooked meat ($M = 4.14$, $p = .005$). Presenting the pulses burger ingredient raw also decreased the burger purchase intention in comparison to the cooked meat ($p < .001$), but not to the raw meat ($p = .302$).

A one-way ANOVA with burger condition predicting healthiness perception shows a significant effect ($F(3,763) = 68.56$, $p < .001$). Participants perceived the cooked pulses burger ($M = 5.28$) as equally healthy than its raw version ($M = 5.24$, $p = .747$), but healthier than both meat versions ($M_{cooked} = 4.13$, $p < .001$; $M_{raw} = 3.83$, $p < .001$). The raw pulses' burger was also perceived healthier than both meat conditions ($p_{cooked} < .001$; $p_{raw} = .019$).

Analysis predicting perceptions of how environmentally friendly the burger is also shows a significant effect of the burger condition ($F(3,763) = 133.20$, $p < .001$). Participants perceived the cooked pulses' burger ($M = 4.93$) as equally environmentally friendly than its raw version ($M = 4.97$, $p = .768$), but more environmentally friendly than both meat versions ($M_{cooked} = 3.22$, $p < .001$; $M_{raw} = 3.01$, $p < .001$). The raw pulses' burger was also perceived as healthier than both meat conditions ($p_{cooked} < .001$; $p_{raw} < .001$).

There was also a significant effect of the burger condition on tastiness perceptions ($F(3,763) = 14.34$, $p < .001$). Participants perceived the cooked pulses burger ($M = 4.19$) as tastier than the raw pulses version ($M = 3.70$, $p = .006$), equally tasty to the raw meat condition ($M = 4.17$, p

= .905) and less tasty than the cooked meat condition ($M = 4.87, p < .001$). The raw pulses' burger was judged as less tasty than both meat versions ($p_{\text{cooked}} < .001; p_{\text{raw}} = .009$).

Analysis predicting perceptions of how filling the burger is shows no main effect of the burger type ($F(3,763) = 2.085, p = .101$).

We ran a parallel mediation analysis (Process Model 4, Hayes 2018), including the burger condition as independent factor (pulses in cooked condition as the reference category), burger perceptions as mediators (i.e., healthiness, environmental friendliness, and tastiness), predicting purchase intention. When contrasting the cooked pulses with the raw pulses presentation, results show a significant mediation through tastiness ($ab = -.3852, CI_{95\%}: -.6751; -.1040$). The cooked version was perceived as tastier, what increased purchased intention. When contrasting the cooked pulses condition with the cooked meat condition we find a significant mediation through tastiness ($ab = .5311, CI_{95\%}: .2640; .8037$) and environmentally friendliness ($ab = -.2410, CI_{95\%}: -.4516; -.0475$). Participants perceived the cooked pulses as less tasty than the cooked meat, what decreased purchase intentions. Meanwhile, participants perceived the pulses as more environmentally friendly, what increased purchase intention. We also saw a significant mediation through environmentally friendliness when contrasting the cooked pulses condition with the raw meat condition ($ab = -.2711, CI_{95\%}: -.5050; -.0533$). When contrasting the raw burger with the cooked meat and the raw meat we find a significant mediation through tastiness ($ab_{\text{cooked}} = .9164, CI_{95\%}: .6379; 1.1960; ab_{\text{raw}} = .3685, CI_{95\%}: .0879; .6484$) and environmentally friendliness ($ab_{\text{cooked}} = -.2464, CI_{95\%}: -.4663; -.0547; ab_{\text{raw}} = -.2766, CI_{95\%}: -.5211; -.0596$). The raw pulses had inferior taste perceptions in comparison to both meat options, what decreased purchase intention, but it had a higher environmentally friendliness, what increased purchase intention.

Study 3's results show that consumers' perceptions are more favorable for the cooked (vs. raw) version of a veggie burger made with pulses. This positive effect is due to increased perceptions of tastiness when compared to a raw veggie burger (but not when compared to a meat burger) and heightened environmental friendliness compared to a meat burger.

General discussion

The present research contributes to the understanding of the drivers of consumers' perceptions of PBMA and their impact on food choices (Mai & Hoffman, 2015). We add to past research in this area (Gonzales et al. 2024) by examining how consumers react to ingredient type in a PBMA product and use it as a heuristic to infer perceptions and product evaluations (Sevilla & Kahn, 2014). We show that pulse ingredients evoke stronger perceptions of healthiness and fullness than cereal ingredients, which in turn increases purchase intention. These findings contribute to research suggesting that food's perceived healthfulness has a strong, positive influence on attitudes, purchase intentions, and consumption (Berry and Romero 2021; Rybak et al. 2021; Werle et al. 2013). Regarding the pictorial representation of pulses' ingredients, our findings suggest more favorable reactions for the cooked (vs. raw) version of a veggie burger made with pulses. Taken together, our findings highlight the importance of deploying a diverse communication strategy about PBMA by further investigating the role of ingredient depiction and its subsequent inferences. These findings may also contribute to food policy debates on how to shifting people's diet in order to grow a more sustainable food system (Bublitz et al., 2023; Shaikh et al. 2024).

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Figures



Figure 1. Stimuli used in Study 1



Figure 2. Examples of stimuli used in Study 2



Figure 3. Stimuli used in Study 3