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Preferences for olive oil between taste and healthiness: an incentivised experiment in Morocco and Tunisia

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Abstract

Olive oil is a major agri-food product in North Africa, yet local diets have been shifting toward less healthy, sweeter-tasting oils. To assess consumers' preferences, we conducted an experimental auction with product tasting in Morocco and Tunisia. We focused on national brands of extra virgin olive oils (EVOOs) that varied in polyphenol content—linked to health benefits but also to bitter/pungent taste, often disliked by consumers. Participants stated their willingness-to-pay (WTP) for each EVOO repeatedly, including after receiving information about the relationship between polyphenol content, taste, and healthiness. Using data from over 200 urban consumers in each country, we find limited baseline differences in WTP by taste or polyphenol content. However, providing health-related information increased WTP for bitter/pungent oils relative to sweeter ones, and this effect persisted even after participants tasted the oils again. These results suggest that a simple, targeted message can incentivise healthier oil consumption in a developing country context.

Highlights

- **High-polyphenol olive oils are healthier but bitter/pungent, which is disliked by consumers**

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- **We elicit preferences for extra virgin olive oils in Morocco and Tunisia through an incentivised auction**
- **Providing information on healthiness increases willingness-to-pay for pungent olive oils**
- **The increase persists net of a rebound effect if consumers experience the bitter/pungent taste**
- **A concise, layperson-oriented message can help promote consumption of healthier, domestically-produced olive oils**

Keywords extra virgin olive oil, consumer preferences, experimental auction, willingness to pay, health information, polyphenols

JEL codes D12, D83, D90, Q18

1. Introduction

There is a consensus in the literature that regular consumption of olive oil generates significant health benefits (Vitaglione et al. 2015). Such benefits derive primarily from olive oil's phenolic compounds (Cicerale et al. 2010; Berrougui et al. 2015; Clodoveo et al. 2022). Nevertheless, higher polyphenol content also results in a bitterer taste and a stronger pungent mouthfeel (Barbieri et al. 2015). The extant literature suggests that consumers in the Global North prefer olive oils characterised by a sweeter taste and lower levels of bitterness and pungency (Delgado and Guinard 2011; Recchia et al. 2012; Valli et al. 2014; Piochi et al. 2021). Therefore, if consumers' choices are based primarily on taste, most would miss the opportunity to consume healthier olive oils. They would opt for sweeter alternatives such as refined olive oil or seed oils instead (Vitaglione et al. 2015). Indeed, although *ceteris paribus*, consumers prefer healthier products (Ran et al. 2017), contrary to taste, healthiness is a non-visible attribute (i.e. a 'credence attribute').

Given the above dilemma, in this article, we investigate whether the dislike for bitterness and pungency extends to consumers from North Africa, and whether a health-focused nudge can help increase preferences for oils with these sensory characteristics relative to sweeter ones.

Olives and olive oil are important agri-food products in the Mediterranean region, where they make a significant contribution to the livelihoods of local farmers. Olive oil is also a key component of the local, Mediterranean diet (Bach-Faig et al. 2011). Among North African countries, Tunisia and Morocco—which are the focus of our study—stand out for the importance of their olive oil sectors, having consistently occupied top positions worldwide in terms of production and export since at least 2010. Nevertheless, domestic per capita consumption of olive oil is significantly lower than in other producing countries in the Global South and the Global North, and has been declining (Drogue et al. 2020; Azenzem 2022; Ouertani and Dhraief 2022; Fort et al. 2025).

The finding that consumers prefer oils with a sweeter taste and lower levels of bitterness and pungency is based mostly on research conducted in the Global North. Studies on consumers from the Global South are either missing, or provide contradictory results. Nevertheless, Ben-Hassine et al. (2022a), who focus on Tunisia, argue that olive oils with high intensity of bitterness or pungency are 'hardly marketable in emergent markets.' This suggests that consumers in the Global South face the same dilemma between taste and healthiness.

While determining the direction of causality between availability, affordability, and consumer preferences is beyond the scope of this article, we are in the presence of a vicious cycle with negative outcomes in terms of health and nutrition. Therefore, in both countries, there is a need to promote the consumption of domestically produced olive oil to improve public

health, support the livelihoods of local farmers, and reduce dependence on imports (Drogue et al. 2020; Azenzem 2022; Ouertani and Dhraief 2022).

We can assume that average consumers who express preference for sweeter oils are unaware of the relationship between bitterness, pungency, and the concentration of phenolic compounds (Barbieri et al. 2015). Knowledge of this relationship falls under the scope of 'food literacy,' a concept used in policy and practice to refer to an individual's set of resources, capabilities, knowledge, skills, and behaviours needed to make healthy food choices aligned with nutritional recommendations (Wijayaratne et al. 2018). Increasing consumers' food literacy is a powerful policy tool to improve public health outcomes. Information nudges, generally through labelling, are a key strategy to signal a product's credence attributes, particularly if there is a mismatch between these attributes and consumers' sensory perception. As a key nudging intervention, labels belong to 'knowledge-based change' interventions (Arno and Thomas 2016), that aim to increase consumers' literacy about credence attributes of food products. Displaying simplified messages on packaging, such as labels, has been found to increases consumers' understanding of health recommendations and, therefore, the probability that they make healthier food choices (Arno and Thomas 2016; Shrestha et al. 2023). However, labels are often characterised by an overly technical terminology, which is not easily understood by the average consumer. For instance, although the benefits of olive oil's polyphenols to human health have been validated by many studies, their communication is hindered by the lack of dialogue across scientific disciplines that use different terminology (primarily food science, pharmacology, and medicine) (Clodoveo et al. 2022).

We advance the extant literature in several ways. First, most studies on olive oil focus on stated preferences following sensory analysis, or rely on a panel of consumers with expertise in olive oil tasting. We overcome the hypothetical bias by conducting an incentivised laboratory experiment, and improve the external validity by focusing on representative samples of urban consumers. As a proxy of consumers' preferences, we register their willingness-to-pay (WTP), as in Caracciolo et al. (2020). Second, instead of providing information about all attributes at once, we disentangle their specific impact through the progressive release of information. Third, rather than using the overly technical terminology generally adopted in labels to communicate health benefits, we focus on a concise, layperson language message unveiling the link between polyphenol content, bitterness and pungency, and health benefits.

Our study was conducted in the framework of an international project focused on promoting healthier, more localised, more diverse food value chains across Africa.[1] Indeed, better understanding of consumers' preferences could help promote the consumption of healthier olive oils.[2] Local producers and processors could improve their products, and market them more effectively, while increased awareness could help consumers make more informed choices. Even if Morocco and Tunisia share similar cultural contexts, consumers in the two countries may still display different preferences, for example because of the different olive cultivars grown and the resulting taste habits. A comparative approach could increase the robustness as well as the external validity of our results, allowing for a more informed discussion.

The rest of the article is structured as follows. Section 2 provides an overview of the olive oil sector and previous studies on consumers' preferences for olive oil in Morocco and Tunisia, as well as on the role of information in promoting healthier food choices. These elements underpin our research hypotheses, set out at the end of that section. Section 3 illustrates our protocol, data collection procedure, empirical models, and estimation strategy. Section 4 presents and discusses the results. Finally, Section 5 concludes and draws policy implications.

2. Background and research hypotheses

In both Tunisia and Morocco, the olive sector holds a prominent position within the agri-food economy. In Tunisia, olive trees cover 1.8 million hectares, accounting for 79 per cent of the area dedicated to perennial trees, and 34 per cent of the arable land (ONAGRI 2020). The country has consistently ranked among the top olive oil producers and exporters globally in the last decade (FAO 2025). Approximately 80 per cent of the domestic production is exported, primarily to Spain and Italy, with bulk exports accounting for 85 per cent of total, compared to 15 per cent for bottled oil (Fernández-Uclés et al. 2020; ONAGRI 2020). In Morocco, olive trees cover 1.1 million hectares (65 per cent of the national arboreal area), and olives represent the second largest agricultural production after cereals (MAPMDREF 2020), accounting for 5 per cent of the agricultural GDP and 7 per cent of agricultural exports (Cour des Comptes du Maroc 2019). Although less than Tunisia, this country has also played a prominent role in the global production and export market of olive oil and, even more, olives (FAO 2025; IOC 2025).[3]

The domestic olive oil market is similar in the two countries, with this product covering a large yet not majority share of the national consumption of edible oils: less than 30 per cent in Tunisia according to the most recent data (Tunisian National Institute of Statistics, 2015), and 19 per cent in Morocco (IOC 2019). Additionally, per capita consumption is lower than in most producing countries.[4] In Tunisia, the government opted for exporting most of its production (Ben-Hassine et al. 2022b), and designed an incentive system aimed at achieving this goal—by subsidising other vegetable oils such as maize, sunflower, and soybean (Drogue et al. 2020; Ouertani and Dhraief 2022; Fort et al. 2025). In parallel, Tunisian consumers have switched towards these sweeter, generally imported oils (Drogue et al. 2020). Already in 2015, the national household budget survey found a low incidence of olive oil on internal oil consumption—7.4 kilograms out of 25.7 kilograms of per capita annual consumption (Tunisian National Institute of Statistics 2015). In Morocco, consumers have been moving away from the Mediterranean diet, characterised by its strong reliance on olive oil, since the beginning of the century (El Rhazi et al. 2012), resulting in a high dependence on imported vegetable oils (Azenzem 2022).

In both countries, bulk purchases directly from producers—family, friends, or neighbouring oil processing units—during the harvesting period are very common. For instance, 40 per cent of consumers in Morocco (Interprolive 2012) and over 80 per cent in Tunisia (Ouertani and Dhraief 2022; Fort et al. 2025) opt for this procurement strategy. Bottled olive oil accounts for a small share of the market, mostly in large cities (Ouertani and Dhraief 2022). On the one hand, this implies a key role for short supply chains and trust in the supplier, as highlighted by Chrysochou et al. (2022) for Tunisia. On the other hand, the presence of poor-quality olives and olive oil in the market leads to distortions in quality perception and, consequently, in the decision-making process regarding purchases (El Badaoui et al. 2017). Bulk sales of food products were also the standard in developed countries prior to the rise of modern mass markets (Cochoy 2018). In Spain—the largest global producer of olive oil—they remained the dominant marketing channel for this product until roughly three decades ago, but are now marginal (Boza et al. 2023). This trajectory suggests that Morocco and Tunisia may undergo a similar transition in the coming decades, highlighting the need to better understand consumers' preferences for bottled olive oil.

To sum up, olive production is a fundamental component of the agricultural sector and of the broader economy in both countries, but it faces various challenges. The predominance of bulk sales both domestically and in the export market causes a loss of identity, resulting in poor added value (Cour des Comptes du Maroc 2019; Fort et al. 2025). Additionally, this situation makes it impossible to set up an effective quality control and traceability system on a national

scale, at least in Morocco (Rahmani 2016). These considerations point to the need to understand consumers' preferences and willingness-to-pay for different types of olive oil in order to build awareness of what constitutes a healthy and, hence, higher-quality product, and to incentivise better market practices in turn.

2.1. Consumers' preferences for olive oil in Tunisia and Morocco

There is a growing body of literature on consumers' preferences for olive oil.[5] This trend is evident for Tunisia, with most studies published after 2010. Before then, research on olive oil in this country had focused primarily on olive oil's organoleptic characteristics from a food technology perspective, with limited attention given to consumers' preferences. In turn, to the best of our knowledge, no peer-reviewed studies exist for Morocco, but only some technical reports.

The current research on consumers' preferences for olive oil in North African countries tends to rely on hedonic ratings after tasting (Ben Hassine et al. 2014, 2015; Ben-Hassine et al. 2022a) or after provision of information about the oils (Dekhili and d'Hauteville 2009). Best—worst scaling (Dekhili et al. 2011; Chrysochou et al. 2022) and discrete choice experiments (Dekhili and d'Hauteville 2009) were also used. Additionally, in at least one study, the sample consisted of a panel of trainee cooks who were already aware of the positive attributes of olive oil (Ben-Hassine et al. 2022a).

Polyphenol content and taste are among the most widely researched attributes. For instance, Dekhili et al. (2011) found that in Tunisia, taste is the most important of 13 attributes. This is also the case in Morocco, where taste was indicated as the main driver of purchase decisions by 26.8 per cent of respondents to a survey, ranking it at the top of preferences (Interprolive 2012). Tunisian consumers generally prefer olive oils with a stronger flavour rather than mild oils (Mtimet et al. 2013). However, there is conflicting evidence surrounding their preferences for pungency and bitterness, with some studies suggesting that they prefer olive oils high in polyphenols (Ben-Hassine et al. 2022a),[6] and others indicating that they dislike them (Ben Hassine et al. 2015). Ben Hassine et al. (2014) assessed Tunisian consumers' preferences for olive oils with different sensory profiles and examined how these relate to undisclosed attributes such as cultivar, polyphenol content, and the system used to extract the oil. Contrary to most studies, they found that consumers prefer pungent oils. Ben Hassine et al. (2015) suggest that appreciation of bitter and pungent oils is linked to familiarity with such taste, which could in turn explain why, in the taste preference studies based in the Global North, these attributes are often disliked.

Origin is a key attribute that deserves further focus. A literature review by Erraach et al. (2021) found that both country and region are important to consumers, with people from olive oil producing areas generally preferring oils from their own country or region. Chrysochou et al. (2022) found that the country of origin is more important to Tunisian consumers than to consumers from France or the US. However, using the same method, Dekhili et al. (2011) found that in Tunisia, contrary to France, the region of origin is more important than the country. One explanation for this is that imported olive oils are common in France but not in Tunisia (Dekhili et al. 2011). Conversely, Mtimet et al. (2013) found that the region of origin does not significantly influence Tunisians' purchasing decisions. Tunisians' attitudes towards regional and quality labels may be influenced by the established habit of purchasing olive oil in bulk from local mills (Dekhili and d'Hauteville 2009; Mtimet et al. 2013). Furthermore, while origin labels are sometimes used as markers of quality (Erraach et al. 2021), Tunisians are mostly influenced by the origin of the olive variety, since they value single-variety oils more (Dekhili and d'Hauteville 2009). In the only study available for Morocco (Interprolive 2012), origin was indicated as the

main driver of purchase decisions by 11.5 per cent of respondents, well below taste, and after quality, price, and colour. Interestingly, the same study found that healthiness was the least important attribute, with only 8 per cent of the respondents considering it (ibid.).

Besides the above attributes, the type of olive oil ('extra virgin' or others) has also been considered in consumers' preferences studies. Chrysochou et al. (2022) found that this is the most influential factor for Tunisian consumers (and those from France and the US). Mtimet et al. (2013) found that Tunisian consumers appreciate the difference between olive pomace oil, virgin olive oil, and extra virgin olive oil (EVOO), and are willing to pay more for the latter two compared with the former, and the most for EVOO. In contrast, Dekhili et al. (2011) found that the 'extra virgin' label is not particularly important to Tunisian compared to French consumers. This aligns with what was observed in Morocco, where the lack of a price premium discourages investments in the sector (Rahmani 2016). However, these preferences may depend on the consumer category, as it may be difficult to distinguish between EVOOs and other types when purchasing olive oil in bulk (Mtimet et al. 2013). Here, we only focus on EVOOs (the best-quality product), evaluating them prior to fieldwork to ensure that they meet the required standards to be awarded this label. Indeed, we consider EVOO, virgin olive oils, and pomace olive oils to be non-substitutable products. Nevertheless, we check consumers' awareness of the definition of 'extra virgin.'

The above overview reveals a need for additional research in Southern Mediterranean olive oil producing countries, primarily Morocco. This research could investigate whether preferences differ significantly from those in developed countries, where most studies have been conducted to date, and assess the potential for developing a premium domestic market.

2.2. Healthiness information in the promotion of olive oil

The provision of better information can increase the salience for individual consumers of characteristics of a product that are not immediately visible, like health and nutrition benefits, or that can only be appreciated in the long term, like environmental sustainability. As such, information, or 'knowledge-based change' (Arno and Thomas 2016), can act as a nudge towards certain consumption choices (Cadario and Chandon 2020). The impact of information provision on the healthiness and nutritional quality of diets has been extensively tested in the literature, generally by means of randomised controlled trials or other non-randomised interventions. Some examples are the comprehensive literature reviews by Arno and Thomas (2016), Shangguan et al. (2019), Harbers et al. (2020), and Shrestha et al. (2023). Market-based policy interventions, such as subsidies and other financial incentives, are generally more effective than information-based approaches in promoting healthier and more nutritious diets (Pinho-Gomes et al. 2021; Huangfu et al. 2024). Additionally, they can be improved by means of behavioural insights (Boonmanunt et al. 2023). However, information-based interventions such as labelling (assessed by Arno and Thomas 2016; Shangguan et al. 2019; Harbers et al. 2020; and Shrestha et al. 2023) can also be enhanced through behavioural approaches (Cadario and Chandon 2020). Since information-based interventions entail lower costs for public finances (Arno and Thomas 2016), it is worth exploring them in the first instance. Other information-based interventions, such as social marketing campaigns that do not provide information directly on packaging, have been found to have low cost-effectiveness (Pinho-Gomes et al. 2021).

In the case of EVOO, the provision of health information is quite standardised, at least in the Global North, limiting the opportunities for conveying the message in alternative ways. For instance, the EU Regulation 1924/2006 established a health claim on olive oil polyphenols, usually reported on olive oil bottles. The claim states: 'Olive oil polyphenols contribute to the protection of blood lipids from oxidative stress. Health relationship: protection of LDL particles from oxidative damage.' However, as argued in Section 1, labels often use excessively technical ter-

minology. In particular, the above claim regarding polyphenols in EVOO is found to be less understandable than other claims that can be placed on the same product (e.g. the health claim for vitamin E) (Pichierri et al. 2021). Additionally, no other health claims related to olive oil have been approved (Clodoveo et al. 2022). Therefore, it is less effective in communicating its beneficial characteristics to consumers.

Given the above considerations, we did not focus on evaluating the impact of the EU health claim, but rather on the communication of information related to the beneficial aspects of EVOO. We highlighted that these benefits are linked to a specific organoleptic component (polyphenols) which is also responsible for the perception of bitterness and pungency (Vitaglione et al. 2015). Additionally, Tunisia and Morocco are not EU countries, and domestic consumers typically purchase olive oil in bulk. Therefore, what truly mattered was communication within short supply chains, where raising awareness about the health benefits and positive sensory characteristics of EVOO remains necessary. This is suggested by the (limited) evidence from Morocco, where 'healthiness' was found to be the least important driver of olive oil purchasing decisions (Interprolive 2012). Hence, we elaborated a concise, layperson-oriented message linking polyphenol content and taste to healthiness, which could easily be reported on the containers used for bulk purchases or conveyed by the seller. The message, refined after pretesting, was as follows: *'A pungent or bitter taste of olive oil indicates higher content of polyphenols. Olive oil polyphenols are good for your health. Therefore, healthier olive oils are likely to be more bitter and more pungent.'* The message was translated into Arabic in the final study setup.

2.3. Research hypotheses

Based on the above literature on olive oil preferences in the two case study countries and beyond, and on the impact of information nudges in food consumption, we formulate and test the following research hypotheses:

Hypothesis 1 (H1): *When experiencing taste only, without information about its relationship with polyphenols and health, consumers have a lower WTP for bitter/pungent olive oils compared to sweet ones*.

Hypothesis 2 (H2): *When provided information about polyphenol levels only, without information about its relationship with taste and health benefits, consumers' WTP does not differ significantly across polyphenol levels*.

Hypothesis 3 (H3): *Providing information on the relationship between polyphenol content and health benefits increases consumers' WTP for high-polyphenol olive oils relative to low-polyphenol ones*.

Hypothesis 4 (H4): *The relative increase in WTP for high-polyphenol oils compared to low-polyphenol ones persists when consumers are confronted with the bitter/pungent taste*.

3. Data and methods

'Stated preferences' may be subject to hypothetical bias (Haghani et al. 2021). Therefore, we elicited consumers' preferences through an experimental auction (Becker and DeGroot 1974), where decisions have actual consequences for their welfare via their financial endowment. Such 'revealed preferences' have been found to have higher external validity (Lusk and Fox 2003; Levitt and List 2007; Chang, Lusk and Norwood 2009).

3.1. Study protocol

Our auction protocol builds upon the approach by Lange et al. (2002), as adopted by Barlagne et al. (2015), and Bougherara and Combis (2009). It was implemented in a laboratory setting and included product tasting.[7] As a proxy for consumers' preferences, we measured their willingness-to-pay (WTP), i.e. a form of valuation related to perception that represents the maximum amount of money they would pay for a product or service described by a given set of attributes. Most of the studies conducted in Northern Africa and cited in Section 2.1 rely on binary or categorical outcome variables to measure consumers preferences. This is also the case of many studies on olive oil conducted in the Global North (e.g. Delgado and Guinard 2011; Recchia et al. 2012; Valli et al. 2014; Piochi et al. 2021), with Caracciolo et al. (2020) being a notable exception. We measured WTP as a continuous variable, which embeds more information about preferences, and focused on how it varied depending on the olive oils' characteristics.

The BDM mechanism is the second most popular elicitation method in the literature after second-price auctions (Canavari et al. 2019). Caputo et al. (2023) suggest that real choice experiments (Alfnes and Rickertsen 2011), which integrate economic incentives through actual choices, are preferable since they allow real-time comparison of the options, and generate WTP estimates that deviate less from underlying values. Nonetheless, we adopted the BDM protocol for three main reasons. First, the collinearity of healthiness, polyphenol levels, and pungent/bitter taste prevented us from including these attributes jointly in a choice experiment design. Second, tasting can only take place sequentially and thus requires repeating the same step as many times as there are available products. Third, we did not have the possibility of gathering an auction group in the same place at the same time. Canavari et al. (2019) suggest that this issue can be overcome by relying on two-person groups in different rooms, as in our data collection context. However, we wanted to avoid the altruistic bidder issue as well as interdependency between participants' decisions, which could reduce transparency and undermine trust in the overall process. Indeed, developing-country contexts are generally characterised by low level of 'generalised interpersonal trust' (Ortiz-Ospina et al. 2016; Roth 2025), which could well extend to the experimental team. Nevertheless, to mitigate potential bias in WTP values, at the recruitment stage we screened potential participants based on their knowledge of the price of one litre of olive oil with good approximation, and excluded those who failed to meet this criterion from the study.[8]

In the BDM procedure, participants are asked to evaluate different product profiles along multiple stages and state their WTP for each profile at each stage. To avoid hypothetical bias, the experiment is incentivised as follows. At the end of the procedure, a product profile, a stage, and a price are extracted. If the WTP of the consumer for the extracted product in the extracted stage is equal to or greater than the extracted price, they must purchase the product at the extracted price using part of the allowance provided to them by the experimenters; otherwise, they are paid their full allowance. In our protocol, we disclose additional information at each stage with the aim of assessing its impact on WTP.

Some authors have shown that the BDM mechanism can effectively prevent the anchoring that characterises hypothetical decisions (Brzozowicz and Krawczyk 2022). Others suggest that anchoring risk may arise from reference prices and expectations (Vassilopoulos et al. 2024). To mitigate this risk, our protocol involved multiple products with different characteristics, whose order was varied across stages and across participants. Because both the evaluation stage and the product on sale were only revealed at the end of the evaluation process, any specific product—stage combination represented a low-probability event. This design helped limit strategic 'misbehaviour,' by discouraging participants from consistently referencing prior bids when stating their WTP (Canavari et al. 2019). Second, participants were not provided with the range of possible prices but only informed that the selling price would never exceed

Table 1 Attributes, levels, and stage of disclosure to consumers.

Attributes	Levels
(a) Polyphenol content	Low; high
(b1) Taste (sensory)	Sweet/non-pungent
(b2) Taste (declared)	bitter/pungent
(c) Healthiness	Less healthy; healthier
(d) Origin	National (Tunisia/Morocco); local (Sousse/Meknès)

their stipend. This was required for ethical reasons. Therefore, we created a situation of almost 'reference-independent preferences,' whereby the BDM mechanism allows drawing conclusions with stronger external validity (Vassilopoulos et al. 2024). Third, to familiarise participants with the experimental protocol, they completed two training rounds in which they evaluated simple, non-suggestive products. Engagement in training rounds also helped reduce anchoring (Sugden et al. 2013). Fourth, since we are interested in the impact of within-subject treatments (different information conditions across stages), we focus on variations in WTP values across stages rather than on absolute values. Nevertheless, consumers could have anchored their bids to exogenous reference prices. To control for this, we also estimate models using as the dependent variable the 'relative WTP,' obtained by dividing each participant's WTP values by the price they usually paid for one litre of olive oil, as declared at the recruitment stage. More information on the protocol implementation is provided in Section 3.1.2, while the modelling approach is detailed in Section 3.2.

3.1.1. Attributes and levels

The number of stages, the oil profiles, and the attributes used to describe those profiles were selected through an iterative process. Besides our hypotheses, we considered the need to limit the duration of the experiment to maintain consumers' attention, the interests of project stakeholders, and the availability of oils characterised by different combinations of the levels of the attributes selected. Ultimately, our design includes four attributes, listed in Table 1 together with their possible levels: (a) the polyphenol content; (b) the taste; (c) healthiness; and (d) the origin. Additionally, the taste can be either described or appreciated through actual testing, adding a further nuance.

We include the origin because of its importance in the debate on consumer preferences, as shown in Section 2.1, and to derive useful information for project stakeholders. We define 'local' as originating from the region where the study was conducted, and 'national' as originating from anywhere in the country. In the latter case, we did not specify a particular region to minimise region-specific biases and enhance the generalisability of the results. This was explained to the participants at the beginning of the experiment to ensure coherence in their interpretation of the attributes.

However, polyphenol content, taste, and healthiness are collinear: the olive oils with higher polyphenol content are more bitter/pungent, and healthier. Therefore, it is not possible to disentangle the specific impact of these three attributes on WTP if they are presented jointly. Moreover, according to the extant literature and our hypotheses, they may impact WTP in opposite directions. To overcome this challenge, participants were asked to evaluate the same oils repeated times, with collinear attributes used alternatively, and only linked together at a later stage, as described in Section 3.1.2.

3.1.2. Study setup

Consumers were asked to evaluate the oils along five stages.[9] A protocol with a similar number of stages and products has been convincingly demonstrated by Barlagne et al. (2015).[10] At each stage, participants received additional information or were given the opportunity to integrate pieces of information received separately at previous stages. The stages are described in Table 2. The last column reports the attributes used to describe the oils at each stage. The differences in the WTP values declared at each stage allow us to test our hypotheses. At **Stage 1**, the participants could only base their WTP on the sensory perception of the taste. Hence, if **H1** is true, we would observe lower WTP for bitter/pungent oils at this stage. At **Stage 2**, they could only base their WTP on the description of the origin and polyphenol content. Hence, **H2** can be tested by looking at WTP values at this second stages. At **Stage 3**, the previous information was linked together and complemented with the health-related message, allowing us to test **H3**. Finally, at **Stage 4**, the taste, which was only declared at Stage 3, was linked explicitly with the rest of the information, allowing us to test **H4**.

Testing all these hypotheses requires independence between the evaluations at each stage, which was achieved by swapping the order of the oils after each stage.[11] However, to reduce complexity for the enumerators, especially given the need to handle the oil-tasting stage manually, a randomisation plan with four different orders was created. All consumers tested on the same day followed the same stage-specific orders, which were changed only on the following day; this pattern was repeated every four days. We deviated from the standard BDM procedure insofar as the oil profile sold each day was predefined rather than randomly extracted; however, it was not revealed before the auction.[12] We recorded the WTP in local currency (Tunisian dinars -TND- and Moroccan dirhams -MAD-) and for one litre of oil. The selling price was extracted electronically and was always lower than the allowance, to ensure that participants received a show-up fee. The entire procedure took place on a computer screen.

3.1.3. Olive oil profiles

Once the attributes and their combinations were defined in abstract terms, we identified real olive oils matching those profiles, to be tasted and sold in the auction. In both countries, local researchers defined a preliminary list of ten brands of 'virgin' olive oil available on the market. These were sensory-assessed to select, for each level of the origin attribute (national or local), a profile with low bitter/pungent, and one with high bitter/pungent.

The oils also had to meet the criteria to be considered 'extra virgin,' i.e. free of sensory defects. A sensory analysis was thus performed by trained assessors of the Department of Agricultural and Food Sciences of the University of Bologna, Italy. The procedure abided by the methods defined by EU regulations (Reg. EU 2022/2105 and Reg. EU 2022/2104) and the International Olive Council (IOC/T.20 Doc. No. 15/Rev. 10/2018). In particular, the different samples were sensory-profiled according to the intensity of possible defects and the three main 'positive attributes' (fruity, bitterness, and pungency). The perceived intensity was ranked by each assessor on a continuous scale between 0 and 10 after tasting 15 ml of each oil sample at 28 ± 2 °C in the sensory laboratory (IOC/T.20/Doc. No 6/Rev. 1/2007). For each sensory defect and positive attribute, we computed the median score of the eight tasters to obtain the intensity.

Based on this procedure, the EVOOs presented in Table 3 were selected for the study. According to EU Regulation 2022/2104, the 'positive attributes' can be characterised as 'robust,' 'medium,' or 'delicate.' Following the assessment, these oils can be categorised as either 'delicate' (which we describe as having 'low' polyphenol content) or 'medium' ('high' polyphenol content).

Table 2 Stages of the protocol: product conditions and information delivered to participants.

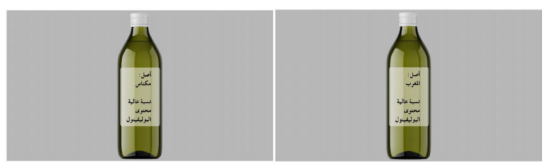
Stage	Description of the stage	Example of images seen by consumers	Attributes disclosed
Stage 1: Tasting	Consumers taste each oil in turn, but see only a mark on the screen.[a]		(b1) Taste (sensory)
Stage 2: Labels	Consumers see generic bottles with information about origin (national vs. local) and polyphenol content (low vs. high). The text on the bottles (in Arabic) says: '*Origin:* [place]. *Polyphenol content: High/Low*.'	 Sample bottles for Meknès (left) and Morocco (right), both with high polyphenol content.	(a) Polyphenol content (d) Origin
Stage 3: Information about health benefits	First, consumers see the following text (in Arabic), which is also read aloud by the enumerator: '*A pungent or bitter taste of olive oil indicates higher content of polyphenols. Olive oil polyphenols are good for your health. Therefore, healthier olive oils are likely to be more bitter and more pungent.*'. Then, they see labels with information about origin and polyphenol content, identical to those shown at Stage 2.	 Sample bottles for Meknès (left) and Morocco (right), both with high polyphenol content.	(a) Polyphenol content(b2) Taste (declared)(d) Origin(c) Healthiness

Table 2 (*Continued*)

Stage	Description of the stage	Example of images seen by consumers	Attributes disclosed
Stage 4: Tasting and labels	Consumers taste each oil in turn, while being shown the corresponding label about origin and polyphenol content, identical to those shown at Stages 2 and 3.[a]	 Sample bottles for Meknès (left) and Morocco (right), both with low polyphenol content.	(a) Polyphenol content(b1) Taste (sensory)(b2) Taste (declared)(d) Origin(c) Healthiness

Note:
[a] In line with good tasting practices, each oil was served on a slice of bread with limited (or no) salt, not crumbly, and without holes, and the consumers were asked to take a sip of water to cleanse their palate before the next tasting.

Table 3 Olive oils selected for the study in Tunisia and Morocco, and their characteristics.

Tunisia	Morocco	Origin	Polyphenol content	Profile (symbol)
Safir	El Mallalia	National	Low	Nat. & Low oil (o_1)
Tesoro del Rio	Ouad Ourika	National	High	Nat. & High oil (o_2)
Ruspina	Meissara	Local	Low	Loc. & Low oil (o_3)
Newman's Own	Volubilia	Local	High	Loc. & High oil (o_4)

3.1.4. Complementary questionnaire

Before embarking on the auction proper, the participants were explained the mechanism. Then, they completed two training rounds. To avoid priming, these rounds used products completely different from olive oils (respectively mobile phones, and toothpaste tubes), whose images were shown on the computer.[13] Furthermore, after the stages of the protocol and before the extraction of the price, they were administered a complementary questionnaire. Among other questions, the questionnaire included a five-levels Likert scale to rate the importance of different attributes for their appreciation of olive oil. The scale was inspired by the eleven food values proposed by Lusk and Briggeman (2009), and reviewed following discussions with local value chain stakeholders. The participants were also asked whether they knew the definition of 'extra virgin,' and whether they knew the relationship between pungent/bitter and healthiness before taking part in the experiment.[14]

The protocol was pre-tested at Copenhagen Business School, Denmark, in May 2022—and refined based on the feedback obtained—, and again with local consumers in the week before the actual fieldwork in each country. The study received ethical approval from the relevant bodies in the case study countries, and written informed consent was obtained from each participant ahead of the start of the experiment. The study was not pre-registered; nevertheless, the full protocol, as well as the complementary questionnaire are freely available online (Piras et al. 2024).

3.2. Data and data analysis

Stratified samples of urban consumers were recruited at shopping venues in the cities of Meknès (Morocco) and Sousse (Tunisia). The samples are representative of the cities' populations in terms of age groups and gender (interlocked strata). Due to the absence of data on education or income distribution at the city level, we were unable to stratify according to these variables. Nevertheless, to ensure diversity in this regard, recruitment took place in different types of shopping venues (modern supermarkets, grocery stores, open street markets, etc.), and across various city neighbourhoods. In addition to ensuring that respondents were over 18 and the main individuals responsible for food shopping in their household, we filtered potential participants according to four criteria. These included: having no allergy to olive oil; regular consumption of olive oil; being involved in grocery shopping at least occasionally; and, as already mentioned, knowing the price of one litre of olive oil with good approximation.[15]

The data were recorded partly using the iMotions® software version 9.3, which tracked consumers' facial and eye movements and registered their WTP, and partly using Qualtrics®, which recorded their responses to the training rounds and to the final questionnaire. All texts were in Arabic. The fieldwork took place in September 2022 in Morocco, and in October—November 2022 in Tunisia. Two rooms were set up *ad hoc* in the premises of local research institutes—establishing experimental economics laboratories was one of the goals of the project—, and

the hardware was provided by researchers from Copenhagen Business School. Two consumers were tested at a time, one in each room, using two different computers. Testing one consumer took up to 30 minutes; therefore, the whole study took several weeks. At the time of fieldwork, no Covid-related restrictions were in place in either country. Nevertheless, all participants were given the opportunity to wash their hands with soap before and after the experiment; disposable face masks and hand sanitiser were provided; and the computers and keyboards were thoroughly cleaned after each test.

The final sample size is 230 in Morocco and 208 in Tunisia, resulting in 3,661 and 3,324 valid instances of WTP, respectively, across all oils and the Stages 1–4 considered in this article.[16] The WTP for each oil and stage, $\boldsymbol{WTP_{i,s,o}}$, was measured in local currency, but to facilitate cross-country comparison, we converted it to $PPP before analysing the results.[17]

As a first step, we present consumers' responses in terms of purchasing habits, knowledge of the definition of 'extra virgin,' knowledge of the relationship between bitter/pungent and healthiness, and importance of different attributes for their appreciation of olive oil. As a second step, we test the differences in WTP across protocol stages, polyphenol content, declared taste preferences, stated knowledge of the relationship between bitter/pungent and healthiness, and combinations of these features. Since most variables are binary, we use *t*-tests—one-tailed if our hypothesis has a direction, two-tailed otherwise. As a last step, we estimate the models whose empirical form is described below.

We estimate models with both absolute ($\boldsymbol{WTP_{i,s,o}}$) and relative WTP ($\boldsymbol{rWTP_{i,s,o}}$) as outcome variables. For each country, and for both absolute and relative WTP, we test two sets of explanatory variables: attribute-level dummies and their interactions with the stages; and olive oil profiles (brands) and their interactions with the stages. The coefficients are similar between models because the design is full factorial, i.e. each possible combination of attribute levels corresponds to an oil profile; nevertheless, the different ways of presenting the information make them valuable for specific audiences. Policymakers might be more interested in the coefficients associated with the attribute levels they may want to promote, while industry stakeholders might be more interested in those associated with the oil profiles. For this reason, we retain the model with attribute level dummies in Section 4.1, but still present the other one in Supplementary material (SM). The former model is more parsimonious because it does not include coefficients for the interactions between attribute levels, which are instead captured by the oil profiles. Its empirical form is the following:

$$WTP_{i,s,o} = \alpha + \gamma_s r_o + \delta_s p_o + \theta c_i + \vartheta t_o + \varphi g_i + \omega a_i + \tau y_i + \varepsilon_i \quad (1)$$

Where $WTP_{i,s,o}$ is the WTP of consumer i at Stage s for olive oil o; r_o is a binary variable for the origin; and p_o is a binary variable for the polyphenol level. The baseline attribute levels are 'national' for the origin and 'low' for the polyphenol content. As controls, we include a dummy for the computer used by i, c_i, to account for the 'room context;' the order in which the oil was shown according to the randomisation plan, t_o; i's gender g_i, age a_i, and income level y_i. The Greek letters indicate the coefficients to be estimated, with γ's and δ's being stage-specific coefficients for the olive oil attribute levels. Finally, ε_i is an unobserved, individual-specific error term.[18]

For both specifications, and for both the absolute and relative WTP, we estimate separate models for Tunisia and Morocco. Since the WTP is censored at zero, we use Tobit models with individual-specific random effects (Goldberger, 1964), estimated using maximum likelihood. To account for correlation between the observations for the same consumer across stages and oils, we cluster the standard errors at the individual level. Moreover, the inclusion of sociodemographics and other control variables, such as the computer used, reduces observed individual heterogeneity. To assess the performance of the models, we report the Bayesian Information Criterion (BIC; Schwarz 1978), and the Akaike Information Criterion (AIC; Findley and

Parzen 1998), which penalise the models with more parameters. No one in Morocco declared zero WTP (and only one in Tunisia); therefore, the estimated coefficients are equivalent to those obtained using an OLS model.[19]

4. Results and discussions

In this section, we illustrate and discuss our results. First, we present descriptive statistics from the complementary survey, including participants' stated preferences for olive oil. Then, we analyse WTP values with respect to the various attributes and stages of the protocol to assess whether our hypotheses are supported.

4.1. Descriptive statistics, oil consumption, and stated preferences

Table 4 reports descriptive statistics by country. Thanks to stratification according to age and gender, the distribution of the respondents according to these variables is in line with the city populations. In Tunisia, 52.9 per cent of the respondents were female, and ages ranged between 20 and 75 years (median 41.5). In Morocco, 48.3 per cent were female, and ages ranged between 18 and 77 (median 47). The samples differ in terms of income level and level of education, with Tunisian participants showing high levels of education, probably due to the more significant presence of higher education institutions in Sousse. Hence, the Tunisian sample can be considered closer to the samples of students generally involved in laboratory experiments conducted in the Global North.

Virtually all participants consumed olive oil every day, or at least a few times per week. The form of purchase was similar, with a large prevalence of bulk purchases and only limited reliance on bottled oils, consistent with the literature (Dekhili and d'Hauteville 2009; Mtimet et al. 2013; Interprolive 2012). At Stages 2–4, we used generic, unbranded bottles as stimuli, similar to those which can be filled when bulk-purchasing olive oil.[20] Furthermore, the most common pattern was to purchase olive oil once a year (during the production season), but with a large difference between countries, as Moroccans were much more likely to do so (80 per cent vs. 49 per cent).

Almost two thirds of the Tunisians and two fifths of the Moroccans in our sample declared that they produce their own oil; and around three quarters in both countries declared that they receive oil from friends and relatives. Hence, 90 per cent of the Tunisians and 82 per cent of the Moroccans could rely on at least one of these supply sources, possibly in addition to oils purchased through other market channels. This is again consistent with the literature, which indicates that local olive oils are widely consumed (Rahmani 2016). Beyond highlighting the importance of controlling for the origin of the oils, these figures suggest that developing a viable market for branded oils may face significant challenges—primarily competition with home production, for which no quality checks are implemented. This in turns highlights the need for further research to better understand market potential.

We focused exclusively on EVOOs and tested the products to ensure that they met the required standards to be marketed as such. Hence, we asked our participants if they knew the difference between 'virgin' and 'extra virgin.' While around half of the participants in either country declared that they did, when asked to select the right response from four options, the gap between countries was significant ($t(436) = 6.50, p < 0.001$), with Moroccans much more likely to respond correctly.

There was a slight prevalence of participants who declared to prefer relatively sweet oils. However, the distribution of taste preferences differed only marginally between countries ($\chi^2(1) = 2.74, p = 0.098$), and not at all when converted into a binary variable. Moreover, around

Table 4 Descriptive statistics for key sample characteristics and explanatory variables, by country.

Variable	Value	Morocco		Tunisia		*p*-value[a]
		n	%	n	%	
Computer[b]	2nd computer	111	48.3	101	48.6	0.951
Gender	Female	111	48.3	110	52.9	0.335
Age	Years (mean, SD)	45.56 (14.51)		42.02 (12.89)		0.008
Monthly income[c]	Low	58	25.2	1	0.5	≠0.001
	Mid-to-low	84	36.5	44	21.2	
	Middle	43	18.7	81	38.9	
	Mid-to-high	22	9.6	60	28.9	
	High	23	10.0	22	10.6	
Level of education	Literate with no qualifications	43	18.7	8	3.9	0.001
	Primary	50	21.7	22	10.6	
	Secondary	82	35.7	48	23.1	
	University	45	19.6	92	44.2	
	Post-university	10	4.4	38	18.3	
Frequency of olive oil consumption	Once a month	1	0.4	1	0.5	0.080
	More than once a month	0	0.0	5	2.4	
	Once a week	13	5.7	6	2.9	
	More than once a week	54	23.5	33	15.9	
	Every day	162	70.4	163	78.4	
Frequency of olive oil purchase	Few times per week	9	3.9	79	38.0	≠0.001
	Once a week	2	0.9	6	2.9	
	Few times per month	6	2.6	5	2.4	
	Once a month	17	7.4	11	5.3	
	Less than once a month	9	3.9	5	2.4	
	Once a year	185	80.4	102	49.0	
	More rarely	2	0.9	0	0.0	
	Never	0	0.0	0	0.0	
Way of acquiring olive oil	In a bottle	14	6.1	10	4.8	0.355
	Both	29	12.6	22	10.6	
	In bulk	187	81.3	176	84.6	
Producing one's own oil	Yes	89	38.7	137	65.9	≠0.001
Family or friends providing oil	Yes	167	72.6	156	75.0	0.571
Either of the two above	Yes	189	82.2	188	90.4	0.013
Knowing the definition of 'extra-virgin'	Yes	124	53.9	92	44.2	0.043
Correct definition of 'extra-virgin' selected	Yes	95	41.3	30	14.4	≠0.001

Table 4 (*Continued*)

Variable	Value	Morocco		Tunisia		*p*-value[a]
		n	%	n	%	
Taste preferences	I am indifferent to it	3	1.3	3	1.4	0.098
	Not pungent/bitter at all	39	17.0	23	11.1	
	Slightly pungent/bitter	113	49.1	99	47.6	
	Pungent/bitter	49	21.3	62	29.8	
	Very pungent/bitter	26	11.3	21	10.1	
Taste preferences binary	Like pungent/bitter or very bitter/pungent	75	33.0	83	40.5	0.109
Knowledge of the taste/health relationship	Yes	191	83.0	165	79.3	0.321
Price paid usually	$PPP (mean, SD)	13.07 (3.68)		14.30 (3.60)		0.001

Notes: The total number of observations is 230 in Morocco and 208 in Tunisia for all the variables apart from 'Taste preferences binary,' whose value is missing for those who responded, 'I am indifferent to it.'
[a] Difference between countries: two-tailed t-tests for binary and continuous variable, Kruskal-Wallis tests ($\chi 2$ with ties) for categorical variables.
[b] It identifies the computer used to test the consumer, and therefore the room context, including the enumerators' team; it is used as a proxy of unobservable contextual factors.
[c] The questionnaire reported actual income ranges relevant for the country where the experiment was conducted.

four fifths of the respondents in both countries declared that they were already aware of the relationship between taste and healthiness. In Tunisia, the correlation between stated taste preferences and knowledge of this relationship was non-significant ($\chi^2(4) = 5.88, p = 0.208$), while in Morocco, those who reported knowing this relationship beforehand stated to prefer relatively more bitter/pungent oils ($\chi^2(4) = 67.10, p < 0.001$).

Before discussing the participants' revealed preferences based on the experimental auction, in Table 5 we report the stated importance of different olive oil attributes based on their responses to a Likert-scale question. The rank of the attributes in terms of average importance score is similar between countries, with limited exceptions, but the values differ significantly, being generally higher for Morocco. 'Taste' is deemed the most important attribute in both countries, in line with the literature from both Tunisia (Dekhili et al. 2011) and Morocco (Interprolive 2012). Both 'price' and 'trust in the producer' ranked high in both countries, with the latter added to the scale following discussions with local stakeholders to reflect the short nature of the local olive oil supply chains and the role of networks. Notably, 'proximity to the production area' and 'origin' rank rather low, confirming what has already been found in past studies for Tunisia (Mtimet et al. 2013) and Morocco (Interprolive 2012).

4.2. Experimental results and the impact of information

The average WTP across all olive oil profiles at Stages 1–4 was 14.22$PPP in Tunisia and 25.34$PPP in Morocco ($p < 0.001$). For Tunisia, it does not differ significantly from the average price paid for one litre of olive oil, recorded during recruitment (14.30$PPP, $p = 0.419$ in a paired *t*-test), but for Morocco, it differs substantially (13.07$PPP, $p < 0.001$). Thus, the relative WTP is almost double in Morocco compared to Tunisia (2.00 vs. 1.03, $p < 0.001$). The Moroccan figures seem to support Caputo et al.'s (2023) observation that the BDM mechanism produces higher WTP estimates. These figures may be driven by the lower level of education of Moroccan par-

Table 5 Average stated importance of different elements for consumers' appreciation of olive oil.

Country	Tunisia (rank)	Morocco (rank)	*p*-value
Taste	4.67 (1)	4.80 (1)	0.011
Trust	4.48 (2)	4.42 (3)	0.419
Colour	4.24 (3)	4.38 (5)	0.066
Price	4.22 (4)	4.41 (4)	0.018
Own milling	4.00 (5)	4.32 (6)	0.002
Olives	3.95 (6)	4.28 (8)	0.002
Seller	3.93 (7)	3.49 (11)	$\not<$0.001
Labels	3.84 (8)	3.18 (13)	$\not<$0.001
Packaging	3.83 (9)	4.49 (2)	$\not<$0.001
Fluidity	3.75 (10)	4.30 (7)	$\not<$0.001
Origin	3.68 (11)	3.97 (9)	0.005
Proximity	3.36 (12)	3.57 (10)	0.045
What others do	3.05 (13)	3.37 (12)	0.004
Advertisement	2.81 (14)	2.30 (14)	$\not<$0.001

Notes: Consumers were asked the following question: '*How important is each of the following elements for your appreciation of the quality of olive oil when acquiring it?*' Importance was assessed on a scale from 1 = 'not important at all' to 5 = 'very important.' The reported figures are averages, while the *p*-values are based on two-tailed *t*-tests.

ticipants, which may have led many of them to see bottled olive oil as a 'positional good,' or a premium product. Additionally, the WTP values for Morocco are in line with the average price of bottled oil in that country, which in 2016 ranged between 50–120 MAD (13–31$PPP), with no significant differences between types (Rahmani 2016).

Tables 6 and 7 report the results of *t*-tests of differences in WTP for specific oil profiles and consumer categories between stages. The results of more *t*-tests are provided in Tables S2 and S3 in SI. Table 8 reports the estimates of the Tobit models with the attributes as explanatory variables, while Table S1 in SM reports the estimates of the models with the olive oil profiles. Based on the BIC and AIC values, the models for Tunisia display a better goodness-of-fit than those for Morocco. Equally, those for relative WTP display a better goodness-of-fit than those for absolute WTP, although we find no significant differences in the direction and relative sizes of the coefficients.

The stated preferences above indicate that, in both countries, consumers tend to slightly favour olive oils that are 'not bitter/pungent at all' or only 'slightly bitter/pungent.' However, the experimental results do not confirm this pattern. Indeed, at Stage 1, when only the taste was disclosed, Tunisian participants were willing to pay 13.52$PPP for bitter/pungent and 12.75$PPP for sweet olive oils ($p = 0.025$), and Moroccan participants 24.31$PPP and 24.02$PPP, respectively ($p = 0.750$) (Tables S2 and S3 in SM). The coefficients for high polyphenol content remain significant among the Tunisian sample in the models in Tables 8, where controls are included, suggesting a slight preference for bitter/pungent oils in that country, *ceteris paribus*. This is not true for Morocco, and might be driven by a more bitter/pungent taste of Tunisian oils, to which consumers may have become accustomed. Notably, the differences in WTP values across polyphenol levels remain non-significant when we consider separately the consumers aware and unaware of the link between taste and healthiness, or those who declared in the survey that they like or dislike bitter/pungent oils (Tables S2 and S3 in SM). The only exceptions are represented by the Tunisian consumers who declared a preference for bitter/pungent oils—their WTP for these oils was significantly higher ($p = 0.022$)—and those already aware of the relationship

Table 6 WTP and difference between stages for olive oils with low and high polyphenol content, and for consumers unaware of and aware of the link with healthiness, in Tunisia.

Group	Sample size[a]	Min. diff.[b]	Stage 1	Stage 2	Stage 3	Stage 4
All olive oil profiles	829–830	0.519	13.14	14.38	14.71	14.66
				1.255***	0.326***	-0.039
Low polyphenol oils	414–416	0.736	12.75	14.04	13.05	13.37
				1.142***	-0.803*** (a)	0.323**
High polyphenol oils	414–416	0.736	13.52	14.92	16.05	15.54
				1.367***	1.458*** (b)	-0.404***
Low polyphenol oils, unaware consumers[c]	86	1.629	13.73	15.11	14.27	14.53
				1.377***	-0.836** (a)	0.258
High polyphenol oils, unaware consumers[c]	86	1.629	14.45	15.12	17.25	16.45
				0.676*	2.127*** (b)	-0.799**
Low polyphenol oils, aware consumers[c]	328–330	0.827	12.49	13.56	12.76	13.10
				1.080 (a)	-0.794***	0.340**
High polyphenol oils, aware consumers[c]	328–330	0.827	13.28	14.83	16.12	15.80
				1.547*** (b)	1.283***	-0.300*

Notes: For each group, the first line reports the average WTP in that stage; the second line reports the average difference between that stage and the previous one, and the significance level (*** 0.01, ** 0.05, * 0.10). The significance levels are based on two-tailed *t*-tests ($Pr(|T| > 0)$), apart from those identified by (a), which refer to left-tailed *t*-tests ($Pr(T < 0)$), and (b), which refer to right-tailed *t*-tests ($Pr(T > 0)$) to align with the directionality of our hypotheses.

[a] It indicates the number of observations per stage, which can vary across stages.

[b] Minimum detectable change in WTP with power 0.8 and significance level 0.05, given a mean of 14.22, a standard deviation of 5.33, and the smallest sample size among those reported.

[c] Consumers are classified as 'Aware' or 'Unaware' based on their previous knowledge of the relationship between bitter/pungent and healthiness.

Table 7 WTP and difference between stages for olive oils with low and high polyphenol content, and for consumers unaware of and aware of the link with healthiness, in Morocco.

Group	Sample size	Min. diff.	Stage 1	Stage 2	Stage 3	Stage 4
All olive oil profiles	905–914	1.371	24.17	24.57	25.87	26.74
				0.484	1.395***	0.693
Low polyphenol oils	452–456	1.943	24.02	23.69	23.32	24.30
				-0.181	-0.424* (a)	0.925***
High polyphenol oils	453–458	1.940	24.31	25.43	28.44	29.18
				1.146***	3.210*** (b)	-0.461
Low polyphenol oils, unaware consumers	78	4.725	18.70	21.64	21.79	21.73
				2.943**	0.149 (a)	-0.056
High polyphenol oils, unaware consumers	78	4.725	17.67	21.85	28.04	26.34
				4.179***	6.182*** (b)	-1.694*
Low polyphenol oils, aware consumers	374–378	2.136	25.11	24.12	23.63	24.83
				-0.825* (a)	-0.543*	1.129***
High polyphenol oils, aware consumers	375–380	2.134	25.67	26.17	28.52	29.76
				0.523 (b)	2.592***	0.909

Notes: See Notes to Table 6.

Table 8 Tobit models for absolute and relative WTP in Tunisia and Morocco, with attributes as explanatory variables.

Variables	Tunisia		Morocco	
	WTP	Relative WTP	WTP	Relative WTP
Stage 1 # Local	-0.490 (0.158) ***	-0.033 (0.011) ***	0.999 (0.360) ***	0.082 (0.029) ***
Stage 2 # Local	0.518 (0.162) ***	0.038 (0.011) ***	0.189 (0.302)	0.014 (0.024)
Stage 3 # Local	0.180 (0.164)	0.016 (0.012)	-0.431 (0.311)	-0.033 (0.025)
Stage 4 # Local	0.152 (0.163)	0.014 (0.012)	0.216 (0.323)	0.020 (0.028)
Stage 1 # High	0.524 (0.164) ***	0.036 (0.012) ***	0.203 (0.364)	0.016 (0.029)
Stage 2 # High	1.439 (0.184) ***	0.108 (0.014) ***	1.712 (0.390) ***	0.139 (0.033) ***
Stage 3 # High	3.073 (0.220) ***	0.225 (0.017) ***	4.995 (0.567) ***	0.388 (0.044) ***
Stage 4 # High	2.664 (0.206) ***	0.195 (0.016) ***	5.449 (0.509) ***	0.430 (0.039) ***
Computer 2 (baseline: Computer 1)	-0.081 (0.628)	0.009 (0.049)	3.128 (1.610) *	0.296 (0.138) **
Order of the oil 2nd (baseline: 1st)	-0.112 (0.138)	-0.005 (0.009)	0.124 (0.315)	0.010 (0.025)
Order of the oil 3rd (baseline: 1st)	0.179 (0.148)	0.017 (0.012)	0.489 (0.399)	0.042 (0.031)
Order of the oil 4th (baseline: 1st)	0.384 (0.167) **	0.029 (0.012) **	1.130 (0.361) ***	0.094 (0.029) ***
Gender female (Baseline: Male)	0.476 (0.600)	0.042 (0.048)	8.772 (1.663) ***	0.530 (0.144) ***
Age in years	0.009 (0.023)	-0.001 (0.002)	0.063 (0.060)	0.004 (0.005)
Mid-low income (baseline: Low)	-1.427 (0.976)	0.357 (0.061) ***	3.866 (2.012) *	0.236 (0.175)
Middle income (baseline: Low)	-1.820 (0.674) ***	0.338 (0.053) ***	4.280 (2.521) *	0.288 (0.219)
Mid-high income (baseline: Low)	-2.948 (0.687) ***	0.269 (0.056) ***	1.897 (3.367)	0.038 (0.267)
High income (baseline: Low)	-3.655 (1.034) ***	0.280 (0.080) ***	1.451 (3.419)	0.074 (0.319)
Constant term	14.776 (0.805) ***	0.636 (0.067) ***	12.096 (3.470) ***	1.120 (0.317) ***
N	3,324	3,324	3,661	3,661
Pseudo R^2	0.014	0.061	0.016	0.027
Log likelihood	-10,135.22	-1,702.82	-14,793.56	-5,790.22
AIC	20,308.45	3,443.64	29,627.12	11,620.44
BIC	20,424.52	3,559.70	29,751.23	11,744.55

between taste and healthiness ($p = 0.025$). Therefore, **H1** is **not verified**: *consumers do not particularly dislike bitter/pungent oils before being informed about the health benefits of polyphenols and their relationship with taste*. In Tunisia, there is even some evidence in the opposite direction. Thus, our results provide slight support for Ben-Hassine et al. (2022a) over Ben Hassine et al. (2015), but cannot offer a clear conclusion regarding the taste preferences of Moroccan consumers.

To test **H2**, we look at the differences in WTP values between Stage 1 and Stage 2, when the labels about polyphenol content and origin were introduced. In Tunisia, we observe a significant increase in WTP for all the olive oils regardless of their characteristics (+1.26$PPP, $p < 0.001$). Such increase is significant for different subsets of consumers, and for olive oils with different polyphenol content, with the unsurprising exception of low-polyphenol oils among aware consumers (Table 6). By contrast, Moroccan consumers show no significant variation on average (+0.484$PPP, $p = 0.140$). Nevertheless, we find a significant increase in the WTP for all oils among unaware consumers and, again unsurprisingly, a marginally significant decrease in the WTP for low-polyphenol oils among aware consumers (Table 7).

The WTP values in Tables 6 and 7 suggest that the label on polyphenol content introduced at Stage 2 did have a significant impact, although the pattern is not straightforward. In the overall Tunisian sample, WTP increases regardless of the polyphenol level. However, when consumers are divided based on their prior knowledge of the relationship between bitter/pungent and healthiness, we observe that WTP for high-polyphenol oils increases more among aware consumers (+1.55$PPP vs. +0.68$PPP). In contrast, the WTP for low-polyphenol oils increases significantly only among unaware consumers. In Morocco, unaware consumers only experience a significant increase in WTP—larger for high-polyphenol oils (+4.18$PPP vs. 2.94$PPP)—whereas aware consumers show a marginally significant decrease in their WTP for low-polyphenol oils (-0.83$PPP). The estimates in Table 8 further indicate that, *ceteris paribus*, at Stage 2 the WTP for high-polyphenol oils becomes significantly higher than that for low-polyphenol oils in both countries.[21]

These results suggest that **H2** is **not verified**: *a label about polyphenol content does impacts WTP, positively in most instances, even without further contextualisation*. For the consumers who were already aware of the relationship between polyphenols, healthiness, and bitter/pungent, the label may have increased the saliency of what was already suggested by the taste. Those who were not aware might have correctly assumed that polyphenols constitute desirable compounds from a health and nutrition perspective, rather than potentially harmful food additives. The impact of polyphenol labels has not been tested previously in these countries.

The coefficients for 'local origin' at Stage 2, when it was disclosed for the first time, are significant and positive for Tunisia. However, their size is around one-third of those for high polyphenol content, and they become non-significant as early as Stage 3 (Table 8). In contrast, local origin seems to have no significant impact on WTP in Morocco. These results are confirmed by the *t*-tests in Tables S2 and S3 in SM, where the WTP does not differ significantly depending on origin at any stage, in either Tunisia or Morocco.[22] Hence, introducing information about origin does not increase consumers' WTP for local olive oils relative to generic national ones. This confirms what was found by Mtimet et al. (2013) in Tunisia as well as the low importance of origin for Moroccan consumers (Interprolive, 2012), and aligns with the stated preferences described above.

To test **H3**, we focus on the difference in WTP values between Stages 2 and 3. The estimates in Table 8 show that at Stage 3, *ceteris paribus*, the WTP for high-polyphenol (healthy) oils is significantly higher than the WTP for low-polyphenol oils. This is confirmed by the estimates in Table S1 in SM, where the oil profiles are used instead. The coefficients for high-polyphenol oils (o_2 and o_4) are significant and positive in both countries, while those for low-polyphenol oils (o_1 and o_3) do not differ significantly from the baseline.

In Tables 6 and 7, we further split consumers based on their prior awareness of the link between polyphenol content, taste, and health benefits. As expected, the increase in WTP for high-polyphenol oils at Stage 3 is larger among previously unaware consumers (+2.13$PPP vs. +1.28$PPP in Tunisia, and + 6.18$PPP vs. +2.59$PPP in Morocco). In turn, the WTP for low-polyphenol oils decreases significantly regardless of awareness in Tunisia, and among aware consumers only in Morocco. The advantage of high-polyphenol oils (already significant in the overall sample) increases from around 1$PPP to more than 3$PPP in Tunisia. In Morocco, it increases from less than 2$PPP to more than 5$PPP, becoming significant (which was not the case previously) among unaware consumers (Tables S2 and S3 in SM). Even the Moroccan consumers who stated not to like bitter/pungent oils declared significantly higher WTP for high-polyphenol oils (Table S3 in SM).

Hence, **H3** is **strongly supported**: *providing information about healthiness increases consumers' WTP for pungent (healthier) oils relative to non-pungent ones*, particularly among previously unaware consumers. This is particularly noteworthy in Morocco, where 'health' was ranked the least important criterion for choosing olive oils in previous studies (Interprolive 2012).

Finally, we test **H4** by focusing on the difference in WTP between Stages 3 and 4, when the participants tasted the oils again. The estimates in Table 8 show that the WTP for high-polyphenol oils is significantly higher compared to the baseline, but is smaller than at Stage 3 in Tunisia. Such dynamics are confirmed by the coefficients for Stage 4 and high-polyphenol oils in Table S1 in SM, which are significantly positive but, again, smaller than at Stage 3 in Tunisia. Additional *t*-tests show that the WTP for high-polyphenol oils decreases slightly in Tunisia (-0.40$PPP) but does not change significantly in Morocco. By contrast, the WTP for low-polyphenol oils increases significantly compared to Stage 3 in both countries, and especially in Morocco (Tables 6 and 7). Notably, the drop in WTP for high-polyphenol oils is larger among (previously) unaware consumers and is significant in both countries. The difference in favour of healthier oils shrinks from more than 3$PPP to around 2.50$PPP in Tunisia, and from more to slightly less than 5$PPP in Morocco. Nevertheless, it remains significant in all subgroups regardless of awareness and stated preferences.[23] Hence, **H4 is supported**: *the relative increase in WTP for high-polyphenol oils persists even when consumers face the bitter/pungent taste, but the gap becomes smaller*. We can thus argue that the impact of information persists.

Beside our hypotheses, the models in Tables 8 and S1 in SM reveal interesting, often country-specific patterns concerning the control variables. First, in neither country is the age of the consumers significantly related to their WTP, while in Morocco, female consumers are willing to pay much more than male consumers, *ceteris paribus* (+8.77$PPP on average). In Tunisia, the better off the household, the *lower* the WTP of the consumer, while in Morocco, only mid-low-income consumers show significantly higher WTP than low-income consumers. This result suggests that bottled oils may be perceived as a 'positional good' by poor consumers, who are thus willing to pay more for it. Instead, when considering their 'relative WTP,' all groups in Tunisia seem to be willing to pay more than low-income consumers, with limited differences between groups. Moreover, the coefficients for the order in which the oils were presented to the participants reveal an increase in WTP for the fourth and last oil in a stage, more pronounced in Morocco. This result confirms the importance of controlling for the order in experiments, as found by Krucien et al. (2017) in a study on discrete choice experiments. Finally, in Morocco, we also detect a significant computer (room) effect. The two rooms were set up in exactly the same way, using the same equipment, and the teams were instructed not to change other conditions across days, including the composition of the experimental teams managing each room. Equally, the allocation of the consumers to the rooms was only based on their order of arrival. It is thus reasonable to assume that, despite extensive training to remain neutral, the attitude, tone of voice, or other subtle behaviours of the teams managing the two rooms may have differed systematically. One

team may have displayed a more positive demeanour, thereby inducing participants to report higher average WTP values.

5. Conclusions and policy implications

We presented the results of a laboratory experiment aimed at detecting consumers' WTP for olive oil in Morocco and Tunisia. We assessed consumers' WTP prior to receiving information about 'credence attributes,' and tested whether information about the health benefits of bitter/pungent olive oils resulted in higher WTP for the products presenting these characteristics.

Most of the previous studies that included olive oil tasting in Tunisia focused on consumers' ability to distinguish sensory characteristics rather than on preferences, and did not measure WTP prior to information provision (Ben Hassine et al. 2014; 2015). Other studies provided information about all the attributes alongside tasting (Dekhili et al. 2011). We advanced this literature by disentangling the impact of different attributes through the progressive release of information, and by using an incentivised experimental setting that addresses the hypothetical bias. Moreover, by adopting exactly the same protocol in two olive oil-producing countries, we shed light on consumers' preferences in an understudied context (Morocco), while allowing comparison with a more studied one (Tunisia). Finally, by focusing on a simple, layperson-oriented message about the health benefits of polyphenols rather than using the overly technical terminology generally adopted in labels, we derive implications that are relevant for a context where bulk purchases are still the norm.

With a view to promoting quality, we only considered EVOOs, and devoted particular care to identifying profiles that presented the characteristics to be classified as 'extra virgin.' This differs from most of the extant studies, which considered different types of olive oils jointly (Mtimet et al. 2013; Dekhili et al. 2011). Furthermore, we focused exclusively on domestically produced olive oils. Indeed, despite the difference that national vs. imported origin could make for consumers, the objective of the H2020 FoodLAND project, within which this study was run, was to support the development of local, healthy food products.

In contrast to the literature on the Global North, participants in our experiment did not show significantly lower WTP for bitter/pungent oils before receiving health-related information, and even declared higher WTP for them in Tunisia. Second, high polyphenol content did result in higher WTP regardless of prior awareness of related health benefits, which indicates that most participants already had a positive perception of this compound. Third—concerning our main research question—a concise message about health benefits increased their WTP for bitter/pungent oils relative to sweet ones, and this impact persisted, despite a small rebound effect, after they experienced the sensory attribute again. The dynamic was similar in both countries. This result confirms that increasing consumers' food literacy through labelling and the display of simple information is a valuable strategy to help them make informed food choices (Arno and Thomas 2016; Shrestha et al. 2023), including in the olive oil sector. Achieving better health outcomes through labelling is a reasonably cost-effective policy option (Arno and Thomas 2016). Labelling could help reverse the move away from traditional Mediterranean diets (El Rhazi et al. 2012), and potentially reduce dependence on imports (Drogue et al. 2020). This is particularly relevant for Morocco, where the only available study, which relies on stated preferences, ranked 'healthiness' as the least important attribute in consumers' purchase decisions (Interprolive 2012).

To communicate health, we did not use the official EU health claim (which may have been difficult for laypersons to understand or may have meant nothing to them). We argue that more efforts should be made to communicate this as well as other food-related information in a way that is meaningful to the average consumer. Additionally, instead of actual branded bottles, we

used standard glass bottles with Arabic text. The same message could be reported on the containers used for bulk purchases, effectively reaching Moroccan and Tunisian consumers despite their current practice of bulk-purchasing olive oil. This approach gives options to communicate quality both in short supply chains, should olive oil remain sold in bulk, or in on bottled oils, should the market evolve in this direction (Boza et al. 2023). Therefore, different consumer segments could still benefit from the same type of information and product quality at a price that is convenient for them.

Our participants showed limited awareness of what constitutes a 'high-quality' olive oil in theoretical terms (i.e. the definition of 'extra virgin'), particularly in Tunisia. Nevertheless, the fact that their WTP for bitter/pungent olive oils was not significantly lower, or even higher, is a solid basis to build upon for advertising quality products. Encouraging them to consume better quality food (here, EVOO with high-polyphenol content) would not be too complex, and the efforts to ensure the population has healthy consumption patterns would not be too costly from a policy perspective.

In addition to the above attributes, we also found that 'local origin' did not result in higher WTP compared to generic 'national origin,' at least for the olive oils and in the regions considered. Our participants appreciated 'national' to the same extent as 'local.' This result differs from many of the extant studies (e.g. Erraach et al. 2021) but partly confirms previous finding that the country is more important than the region for Tunisian consumers (Mtimet et al. 2013; Chrysochou et al. 2022). This might be a challenge when promoting more localised value chains, but it also suggests that consumers may equally appreciate olive oils from other regions in their country.

Finally, our results highlight the importance of comparative studies, as cultural differences could result in diverging food behaviours even within the same region. From a methodological standpoint, this raises awareness of the need to better account for those cultural differences when designing research protocols and elaborating hypotheses. Equally, it calls for a sound assessment of the local context, and how it might impact the research process. For instance, while Tunisian participants displayed higher WTP for pungent/bitter olive oils prior to receiving the information, their WTP was lower on average, and the impact of health information was less persistent. This could be an outcome of the subsidies on other vegetable oils (Fort et al. 2025), and calls for strategies that are tailored to such specific conditions.

Our study presents some limitations. First, even if we filtered participants based on their prior knowledge of the price of one litre of olive oil, most of them were used to purchasing olive oil in bulk; therefore, they might not purchase bottled olive oil in real life. Nevertheless, this market may expand in the coming decades (Boza et al. 2023), and our study provides a valuable baseline assessment. Second, due to the necessity of identifying actual olive oils and avoiding overwhelming consumers, we had to limit the number of attributes and levels, meaning that we excluded additional attributes that may influence real-life choices. Third, also to avoid overwhelming participants, we introduced more than one piece of information at the same stage (namely, polyphenol content and origin), which complicates the identification of attribute-specific effects. Despite such limitations, to the best of our knowledge, this is the first study to test consumers' preferences for olive oil and the impact of health information in Northern Africa relying on actual tasting and a non-hypothetical approach. It is also the first to do so by applying the same protocol in two countries, allowing full comparability. Among other improvements, future research could add more stages or include a third tasting while consumers observe the real, branded bottles.

End notes

1 EU Horizon 2020 'FoodLAND—Food and Local, Agricultural and Nutritional Diversity' (2020–2025), https://foodland-africa.eu/[accessed 6 May 2026].

2 Focusing on consumers' perception of polyphenol content is more interesting than focusing on saturated fat content because of the discrepancy between consumers' sensory appreciation of olive oil and actual health benefits. While the saturated fat content is a characteristic of oils with implications for health, it is not particularly high for olive oils, has no direct relationship with taste, and does not vary significant across olive oil types.

3 Since 2010, Tunisia placed between 2nd and 7th globally in terms of production volume (average rank 4.8), between 3rd and 5th in export quantity (average rank 3.8), and between 3rd and 5th in terms of export value (average rank 4.1). Morocco ranked between 6th and 8th in production volume (average rank 6.5), between 6th and 13th in export quantity (average rank 9.6), and between 7th and 15th in export value (average rank 10.6) (our calculations based on Food and Agriculture Organisation of the United Nations [FAO], 2025). Both countries outperform Algeria, Egypt, and Libya across all three dimensions. Within the Eastern Mediterranean region, only Turkey and Syria surpass Morocco, while neither outperform Tunisia).

4 Based on our calculations using data from the International Olive Council (IOC 2025) and FAOSTAT (FAO 2025), the average olive oil consumption per capita between 2010–2024 has been 2.88 litres in Tunisia and 3.73 litres in Morocco. This is well below other producing countries such as Greece (12.45 litres), Spain (10.57 litres), Italy (8.53 litres), Portugal (6.45 litres), or Syria (5.30 litres), but above Turkey (1.83 litres).

5 A topic search on Web of Science using the string ['olive oil' AND consumer AND preference], conducted on 29 October 2025, returned 256 results, of which 53.9 per cent published from 2020 onward, and 69.5 per cent after 2018.

6 Ben-Hassine et al. (2022a) still state that participants 'appreciated the fruity attribute and, in part, the pungent sensation, whereas they recognise bitterness as a negative attribute,' (p. 876) which somewhat contradicts their own findings that participants preferred polyphenol-rich oils.

7 Our protocol also included the measurement of biometric data to link consumers' conscious response (their WTP) to their non-conscious responses, namely visual attention, and emotions. Visual attention was measured through eye-tracking (Orquin and Loose 2013), emotions through pupil dilation (Bradley et al. 2008), and facial expressions based on the Facial Action Coding System (Ekman and Friesen 1971). These data are beyond the scope of this article and are not discussed further; an analysis of participants' non-conscious responses along all the stages of the protocol is provided in Suurmets et al. (2024).

8 The national experimental teams defined an acceptable price range ahead of recruitment, between half the prevalent local price of one litre of olive oil when purchased in bulk and 10 local currency units above the price of the most expensive oil among those used in the auction.

9 Stage 5 was designed to assess the impact of the real bottles and brands on consumers' WTP. The data derived from that stage are not included in this study for two main reasons. First, all the information related to our hypotheses was already disclosed by Stage 4, and the images of the bottles were not large enough for consumers to read the labels. Therefore, Stage 5 cannot be considered to provide *additional* information about the *same* oils. Second, the generic, unbranded bottles shown at Stages 2–4 more closely replicate the experience of bulk-purchasing olive oil. Hence, the WTP values measured at that stages are likely to align better with real preferences of Tunisian and Moroccan consumers.

10 A protocol involving more stages and randomisation of the stage order was also considered. However, this idea was abandoned due to excessive complexity, and the risk of losing ob-

servations through errors, particularly given that the oil-tasting stages had to be handled manually.

11 Participants were informed that the order of the oils would change and, therefore, they should not make assumptions based on the order of their presentation.

12 Extracting an oil each day would have required us to purchase four bottles for each consumer, raising issues in terms of budget and storage space. The participants were told that at the end of the whole process, they would be informed of the brand of olive oil being sold that day.

13 Consumers were asked to state their WTP for two alternative mobile phones. Afterwards, they were informed which phone was being sold and the price drawn, and were then asked a comprehension question—whether, based on their WTP, they would have to purchase the phone and at what price. If their response was incorrect, the mechanism was explained to them again. The same procedure was subsequently repeated for the toothpaste tubes.

14 This question was asked after the auction to avoid jeopardising the purpose of the study by providing the information beforehand.

15 In the first instance, participants were recruited from a pool of 500 consumers per city who had been previously sampled according to these criteria to take part in a baseline project questionnaire (not on olive oil). The response rate among this group was 42.0 per cent in Morocco (210 consumers) and 24.2 per cent in Tunisia (121). Consequently, additional participants (20 in Morocco and 87 in Tunisia) were recruited following the same criteria to fill the underrepresented strata.

16 Seventeen instances of WTP values in Morocco and three in Tunisia were not registered due to software malfunctioning. Three more instances (one in Tunisia and two in Morocco) were excluded from the analysis since they were more than three IQRs above the third quartile of the distribution, and could thus represent data entry errors.

17 'PPP conversion factor, GDP (LCU per international $),' available at https://data.worldbank.org/indicator/PA.NUS.PPP [accessed 22 February 2024].

18 In the model specification with the olive oil profile (brands), $\gamma_s r_o + \delta_s p_o$ is replaced by $\beta_{s,o}$, i.e. oil- and stage-fixed effects, or, equivalently, $\beta_s(r_o * p_o)$, with the β's representing stage-specific coefficients for each potential combination of attribute levels.

19 Given models' parameters, the minimum detectable difference from zero (with power 0.8, and significance level 0.05) is 0.147 in the model with attribute levels and 0.178 in the model with the olive oil profiles in Tunisia, and 0.140 and 0.170, respectively, in Morocco. Given the values of the R^2's with and without the covariates of interest, the power of the regression models ranges between 0.9 and 1.0 for all models apart from those for absolute WTP in Morocco. The minimum detectable effect in the *t*-tests is reported in the respective tables.

20 The price usually paid by the consumers for one litre of olive oil, detected at the recruitment stage, does not differ significantly depending on the way of purchasing ($\chi^2(2) = 0.698$, $p = 0.149$ for Tunisia, and $\chi^2(2) = 3.81$, $p = 0.149$ for Morocco, based on a Kruskal-Wallis test), suggesting that this aspect is unlikely to bias the results.

21 Additional *t*-tests show that the variation in WTP between Stages 1 and 2 does not differ significantly depending on the polyphenol content in Tunisia (+1.37$PPP for high vs. +1.14$PPP for low, $t(828) = 0.81$, $p = 0.416$), while it does in Morocco (1.15$PPP vs. -0.18$PPP, $t(912) = 2.03$, $p = 0.043$).

22 Additional *t*-tests show that the variation in WTP values between Stage 1 and Stage 2, when the origin is revealed, is significantly larger for local than for national oils in Tunisia (+1.46$PPP vs. +1.05$PPP, $t(828) = 1.46$, $p = 0.073$ in a one-tailed *t*-test). Instead, it differs significantly in the opposite direction in Morocco (-0.03$PPP vs. +1.00$PPP, $t(913) = -1.56$, $p = 0.059$ in a one-tailed *t*-test). However, the WTP does not differ significantly at either stage.

23 The difference among previously unaware consumers in Morocco is still large (over 4.50$PPP) but only significant in a one-tailed t-test ($t(154) = 1.42$, $p = 0.079$).

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Authors' contributions

SP: Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Software, Supervision, Validation, Visualization, Writing—original draft, Writing—review & editing; **CB**: Conceptualization, Funding acquisition, Methodology, Supervision, Writing—original draft, Writing—review & editing; **JC**: Conceptualization, Data curation, Funding acquisition, Methodology, Project administration, Resources, Software, Supervision, Writing—review & editing; **NM**: Funding acquisition, Investigation, Resources, Supervision, Writing—review & editing; **CT**: Funding acquisition, Investigation, Resources, Supervision, Writing—review & editing; **MT**: Funding acquisition, Investigation, Methodology, Resources, Writing—review & editing; **IW**: Visualization, Writing—original draft. All authors have read and approved the final manuscript.

Supplementary material

Supplementary material are available at *Q Open* online.

Conflicts of interest

The authors declare no conflict of interest.

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Data availability

The data used in this study are freely available in the Zenodo repository, at the following link: https://doi.org/10.5281/zenodo.10698832. The Stata do file used for the analysis is provided as Supplementary material.

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