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SENSORY MARKETING: THE INFLUENCE OF GLASS SHAPE ON THE PERCEPTION OF BEER BY THE CONSUMERS

Daman Dubis [1*], Jolanta Baran [2]

[1, 2] Quality Engineering Department, Institute of Technology, State University of Applied Sciences in Krosno, Poland*

E-mails:[1]damian.dubis@pans.krosno.pl (Corresponding author); [2]jolanta.baran@pans.krosno.pl*

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Abstract. In recent years, there has been a growing interest in the issue of how the quality characteristics of glassware affect the consumer experience of drinking. The material, shape and colour of the vessel are important organoleptic features that affect the consumption of beverages. Six types of beer purchased from different producers were selected for the study: light beer, dark beer, porter, castellan, wheat beer, and Ale. Beer samples for evaluation were served in three glass vessels, which differed in shape. The study used beer mugs with a handle, tall glasses for wheat beer, and beer goblets (also called tulip glasses). A trained team performed the sensory evaluation of the beer with appropriate, verified sensory sensitivity, meeting the selection criteria according to the standardized method. The results obtained in this study indicate that the sensory characteristics of beers were rated lower compared to the ratings made by other authors. In the case of light beer, differences in the ratings of taste, palatability and bitterness were noted depending on the type of vessel in which they were served. Light beers' taste, palatability, saturation, and total quality (WJC) were evaluated as lower when this beer was served in a tulip glass. In the case of wheat beer, differences in the ratings of palatability and saturation were noted.

Keywords: beer quality; glass quality; sensory evaluation

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JEL Classifications: L15, L61, L66

1. Introduction and review of literature

In recent years, there has been a growing interest in the issue of how the quality characteristics of glassware affect the consumer experience of drinking (Craine et al., 2022). The material, shape and colour of the vessel are important organoleptic features that affect the consumption of beverages. Research conducted by Guéguen (2003) has shown that the vessel's colour affects the drink's perception – its thirst-quenching properties. The study confirmed that carbonated drinks served in blue glass - which is associated with cold - were rated as more thirst-quenching than when the same drink was served in green, yellow or red glass. Only 15% of participants rated the drink in the red glass more thirst-quenching.

Similar studies were conducted by Piqueras-Fiszman et al. (2011), but the object of their interest was hot chocolate. The results confirmed that the perception of the drink's taste was influenced by the colour of the plastic cup in which the drink was evaluated. The drink served in a red cup was liked more by the evaluators than when

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served in a white cup. The results of subsequent studies by these authors show that the consumer's perception of the sensory properties of the container in which the drink is evaluated (e.g., its colour, weight, etc.) influences the experience of drinking the drink, which is often referred to as the "transfer of sensations" effects. Participants in the study rated hot chocolate samples on several sensory scales. The results showed that the evaluators rated the drink taste in orange and dark cream cups as more chocolatey. In addition, the hot chocolate consumed from the dark cream cup was rated as sweeter, and its aroma was more intense (Piqueras-Fiszman & Spence, 2012).

Research by Schifferstein (2001) clearly showed that participants' experiences of drinking from different cups were influenced by how the participants experienced the cup. Respondents rated carbonated drinks from plastic cups as more acceptable than from ceramic cups. In turn, drinks from pink cups were rated significantly sweeter than when the same drink was consumed from clear cups (Schifferstein, 2001).

Also, orange juice has been tested this way. The results revealed that the glass shape influenced the perceived sensory qualities of orange juice. The results also showed that bar workers and restaurateurs should provide orange juice in glasses with a round shape as it influences perceived sweetness and pleasantness (Wu et al., 2024). The characteristics of the cups made of different materials influenced the overall acceptability of the apple soft drink, so different drinks are affected by the shape of the cup (Tomic et al., 2024).

When it comes to tea, the teacups' height, width, thickness, and smoothness affect the tea's flavour. The shape and texture of the teacup influenced the preference for teacup, and the preference for teacup affected the tea perception's flavour (Yang & Hsu, 2024).

Similar conclusions were obtained in the case of experiments on the effect of the shape of glassware on the organoleptic properties of alcoholic beverages. Wansink and van Ittersum (2003) found that consumers consume up to 88% more alcoholic beverages when serving them in short and wide glasses than when the same beverage is served in tall and narrow glasses. Similar conclusions were drawn from research conducted by Mirabito et al. (2017). They found that panellists consumed alcoholic beverages 60% slower when served from straight-sided glasses compared to when they were served from sloping-sided glasses.

In a study conducted by Vilanova et al. (2008), six sweet wines were assessed, which were served in nine different glasses. Experts assessed the intensity and quality of the aroma and taste of the wine served in different glasses. Assessments were made on an 11-point scale. Depending on the type of glass in which the wine was served, the aroma assessments differed by 1.8 points. Experts assessed the aroma of the wine as the highest when it was served in bulbous glasses (Spence & Van Doorn, 2017). The shape of the glass had a slightly smaller effect on the assessment of the taste of the wine. The evaluation of the aroma and, to a lesser extent, the taste of the wine by social drinkers, students of oenology and professional wine tasters can be significantly influenced by the shape of the glass in which the drink is served.

The experiment confirms that the assessment of the aroma and taste of a wine that potential consumers and experts can consume can be significantly influenced by the shape of the glass in which the drink is served. As Gawel (20210) reports, the same wine served in different glasses will be assessed by respondents completely differently. When asked how many wines they had assessed, most of the participants in the experiment responded that they had two or three. This means that they believed they were evaluating different types of wine when they were served the same kind of wine, which was served in different glasses. The experiment was conducted in a sensory evaluation lab, where the participant did not know the vessel in which the wine was served for assessment. The tests did not indicate differences in the sensory perception of the wine consumed. Perhaps the most interesting result came when the participants were asked how many different wines they had tried during the experiment – most responded that they had two or three. This means they thought they were assessing a different wine when it was served in a different glass. However, in the strictly controlled laboratory conditions, where the participant did not know about

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the glass in which the wine was presented, no detectable differences in the perception of sensory properties by the assessors were reported. This is confirmed by research conducted by Delwiche & Pelchat (2002), who found that it is much more difficult for respondents to distinguish between wines served/stored in different glasses if they cannot see or touch these glasses.

Drinking, unlike eating, always involves direct contact between the drinker and the vessel in which the drink is served (Spence & Wan, 2015; Spence & Van Doorn, 2017). According to Vilanova et al. (2008), in the case of direct contact in the form of holding a glass in the hand of the person tasting the wine, a much greater influence of the glass on the sensory properties of the drink was observed. This insight aligns with the opinion that if the assessor can see and/or physically interact with the wine glass while assessing the sensory properties of the wine contained within it, then the shape and/or size of the glass will influence the assessment of the contents (Hummel et al., 2003). To highlight the intensity and elegance of the wine aroma, it is essential to choose a glass with a smaller cuppa height and a bigger ratio between the maximum and opening diameter, which is practical and instructive for wine practitioners (Bai et al., 2023). The glass's influence on wine perception may be psychological rather than chemical or physical in origin. Also, contextual conditions matter (Istiani et al., 2023a; Istiani et al., 2023b). The subjective evaluation of wine is a conscious multisensory process that includes the direct (visual and/or tactile) perception of the glass, as well as any awareness the participant may have of the meaning and associations associated with the glass itself (Piqueras-Fiszman et al., 2011). Barnett et al. (2016) showed that consumers rated the taste of beer served in a bottle better than the taste of the same drink served in a can. The same authors conducted a study in which several hundred people were asked to drink a bottle of beer and then fill out a survey about their impressions. The participants were divided into groups, and beer was served in different bottles. The results revealed that those who tried the beer from the bottle with yellow and green elements on the label rated the citrus notes as significantly more intense than drinking from an unmarked brown bottle. Also, the results obtained by Becker et al. (2011) confirm that changes in the tactile properties of the container in which the drink is placed have different effects on different people depending on their general preference for tactile stimuli. Meanwhile, research conducted by Casales-Garcia et al. (2023) suggested that the type of beer glass (e.g., Pilsner) and the colour of beer both influence participants' expectations, hedonic ratings and willingness to pay. Beers served in a Pilsner glass were rated as tasting sweeter than when the same beers were served in a mug instead.

The shape of the glass has an extremely high influence on the sensory evaluation of champagne. Research has been conducted for years on whether champagne tastes better when drunk from a flute or cup glass. The shape of the glass significantly impacts the release of carbon dioxide contained in the drink (Liger-Belair et al., 2024).

Some studies of drinking experiences examine the presentation of a beverage in a container that is perceived as appropriate versus one that is perceived as inappropriate. Studies have shown that respondents rate beverages more favourably when presented in containers perceived as suitable for the beverage (Spence & Van Doorn, 2017). Typically, what is considered "appropriate" here is often determined by a history of prior experiences with drinking certain beverages from certain types of glassware. Certain types of glassware are considered to be better suited for certain types of beverages (Casales-Garcia et al., 2023). A person's social, cultural, and cultural context also plays a role. People worldwide may have different ideas about the most appropriate glassware for a particular beverage. Consumers from different cultures and/or age groups may have very different views on the suitability of a specific container for a particular beverage (Standage, 2006; Henriques et al., 2022). It should also be emphasized that glassware affects not only a person's impression of what is in the glass but can also potentially affect their experience of the entire meal (Billing et al., 2008). New designs for the shape, appearance, and functionality of the vessels are constantly being tested. Studies show that the right design positively affects the experience of drinking beverages (Liu et al., 2023; Guo et al., 2024).

Advertising and marketing of glassware, including wine glasses, is so effective that most wine connoisseurs have clear prejudices about whether a glass is suitable for wine. Research conducted by Williams et al. (1984) showed

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that even experts involved in wine evaluation make different assessments of the sensory characteristics of port and Bordeaux wines depending on whether the drinks are served in red or clear glass. Unfortunately, the research results in this area are always difficult to interpret. It is unclear what effect the actual shape of the glass has on the consumer's feelings and what effect the associations generated by marketing activities on the glass market have. Some authors also indicate that it is not entirely clear whether research related to the effect of the shape of the glass on the perception of the organoleptic characteristics of wine will also be translated to other drinks, often of a less complex nature, such as drinks, Cola, beer (Spence & Van Doorn, 2017).

The above review of the literature indicates how many factors can influence the assessment of sensory impressions. New designs are constantly being created to complement previously known glass styles. The abundance of shapes and types of vessels can cause many doubts among consumers when choosing them. Researchers also indicate that it is not entirely clear whether the findings related to the influence of the shape of the vessel on the perception of the organoleptic characteristics of wine will also be translated into other beverages, often of a less complex nature, such as drinks, Cola, beer (Spence & Van Doorn, 2017). It is justified to conduct further research on the influence of the shape of the glass vessel on the impressions resulting from the consumption of various beverages. The results of such studies can be useful for consumers (when choosing glass) and for manufacturers of vessels (when creating marketing strategies). Aspects related to sustainable development are equally important today. Knowledge of the interactions between the drink and the vessel can lead to more thoughtful purchases, as it has been confirmed that consumers' perception of the quality of a drink is undoubtedly an important factor in their product-related decision-making (Mehta et al., 2022). Consumers who choose products closely tailored to their needs also contribute to lower consumption of natural resources.

2. Materials and methods

Six types of beer purchased from different producers were selected for the study: light beer, dark beer, porter, castellan, wheat beer, and Ale. Beer samples for evaluation were served in three glass vessels, which differed in shape. The study used beer mugs with a handle, tall glasses for wheat beer, and beer goblets (also called tulip glasses). Mugs are vessels with a classic appearance characterized by solid construction and a special handle. They are popularly used for beers such as Lager and Ale. A goblet is a vessel similar to a shot glass but with a short stem and a large bowl that narrows towards the top. For example, IPA beer is served in this vessel. The goblet's shape helps to bring out the full aromas of the beer. Glasses with a characteristic tall, elongated shape were designed for wheat beers.

A trained 10-person team performed the sensory evaluation of the beer with appropriate, verified sensory sensitivity meeting the selection criteria according to the standard PN-ISO 6658:1998 (Sensory Analysis – Methodology – General Guidelines) in conditions ensuring accuracy and repeatability of results meeting the requirements of the standard PN-ISO 8589:1998 (Sensory Analysis – Methodology – General Guidelines).

Beer samples for evaluation were poured into vessels of about 100 ml. They were prepared and given to the assessors anonymously. The temperature of the beer samples evaluated was 80C. Beer samples for sensory evaluation were taken and prepared according to PN-A-79095:2000 (Beer research methods - Sampling and preparation). The beer samples were assessed in two sessions. In the first session, 3 types of beer were assessed: light, dark and porter. The beer samples in the first and second sessions were served in three series, which differed in the type of container. In the first series, beer samples were poured into mugs, in the second into glasses, and the third into goblets. In the second session, castellan, wheat and Ale beers were assessed. In each session, each assessor assessed 9 beer samples. The assessment was aimed at determining the level of organoleptic characteristics of beer (odour, taste, palatability, saturation and bitterness) using a 6-point scale according to PN-ISO 4121:1998 (Sensory analysis - Methodology - Evaluation of food products using scaling methods) and

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determining on this basis the overall quality of the assessed beer types. Each point of the scale corresponded to a clear definition of quality. The scale included 6 quality levels of the assessed parameters:
High quality - very good - 6 points; good - 5 points.
Acceptable quality - average - 4 points; poor - 3 points.
Low quality - very poor - 2 points; bad - 1 point.

After each session, an individual sensory quality index was calculated for each type of beer using the following formula:
$WJC = \Sigma C_i * W_i$, in which:
WJC – total quality indicator
C_i – evaluation of the consecutive sensory features;
W_i = weighting coefficient of the consecutive sensory feature (smell = 4, taste = 8, palatability = 12, saturation = 2, bitterness – 4). The weighting coefficients were adopted according to Annex D of PN-A 79093-1-2000-P.

The study used beer mugs with handles (beer mugs), tall glasses for wheat beer (wheat beer glasses), and tulip glasses. The appearance of the glass used in the study is shown in Photo 1.

Photo 1. Glassware used in the study. Beer mug (left), glass (centre), tulip glass (right)
Source: own photography

The results were statistically analyzed using Statistica 13.3 software. The following methods were used in the analysis:

- calculation of basic statistical measures – arithmetic mean (M) and standard deviation (Sd),
- one-way analysis of variance – Fisher-Snedecor parametric F test combined with post hoc analysis, in which the least significant difference (NIR) test was used. These tests were used to examine the degree of differentiation of assessments between individual experts.
- Kruskal-Wallis nonparametric test for a one-way system was used to examine the difference in assessment results depending on the type of beer and the type of vessel used. In the case of rejecting the null hypothesis, an additional post hoc analysis was performed using Dunn's multiple comparisons test with Bonferroni correction

Verification of all hypotheses was performed at the significance level of $\alpha = 0,05$ based on the test probability value "p". It was assumed that $p \leq 0.05$ indicates significant differentiation of the dependent variable depending on the category of the qualitative factor (Stanisz, 2006).

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3. Results and discussion

The results of the organoleptic quality assessment (WJC; mean and standard deviation values) of the tested beers performed by individual experts are presented in Table 1.

Table 1. Results of organoleptic quality assessment (WJC) of the tested beers

Evaluator no.	Mean	Standard deviation
1	4,81	0,40
2	3,86	0,68
3	4,86	0,69
4	5,18	0,82
5	4,68	0,74
6	4,32	0,67
7	4,31	0,68
8	4,77	0,63
9	4,83	0,79
10	4,50	0,88

Source: own study

Test F showed that the average WJC score scores of all beers combined vary depending on the person performing the assessment (Table 1). The NIR test showed that the No. 2 and No. 4 evaluators were remarkably different from the team. Expert No. 2 assessed the organoleptic quality of beers at a significantly lower level than the others (3.86 on average). Expert No. 4 assessed the organoleptic quality of beers at a significantly higher level than the others (5.18 on average). Therefore, further analysis of the results was performed for a team of 8 people, omitting evaluators No. 2 and 4.

3.1 Results of organoleptic quality assessment of the tested beers depending on the type of vessel

The results of the organoleptic quality assessment of all beer samples evaluated in different vessels are presented in Table 2 (mean values for eight evaluators). The nonparametric Kruskal-Wallis test showed significant differences between organoleptic quality. A post hoc analysis of Dunn's test showed that beer served in a tulip glass was rated lower than beer served in a mug and a glass.

Table 2. Results of the organoleptic quality assessment (WJC) of all types of beer evaluated in different vessels

Glass type	mean
beer mug	4,90
tulip glass	4,45
glass	4,73

Source: own study

The study results show that the organoleptic quality of light, dark, and wheat beer is significantly influenced by the type of vessel in which the beer is served. Analysis by the Kruskal-Wallis test showed that the variation of the WJC parameter depending on the type of vessel occurs in relation to light beer, dark beer and wheat beer ($p<0,05$). The Dunn test allows us to conclude that the average WJC level of light beer is highest for samples served in a glass and lowest for samples in a tulip glass. The organoleptic quality of dark beer is lower when it is served in a glass and higher when it is served in a mug and a tulip glass. The organoleptic quality of wheat beer was assessed higher if the samples were given in a mug than other vessels (Figure 1).

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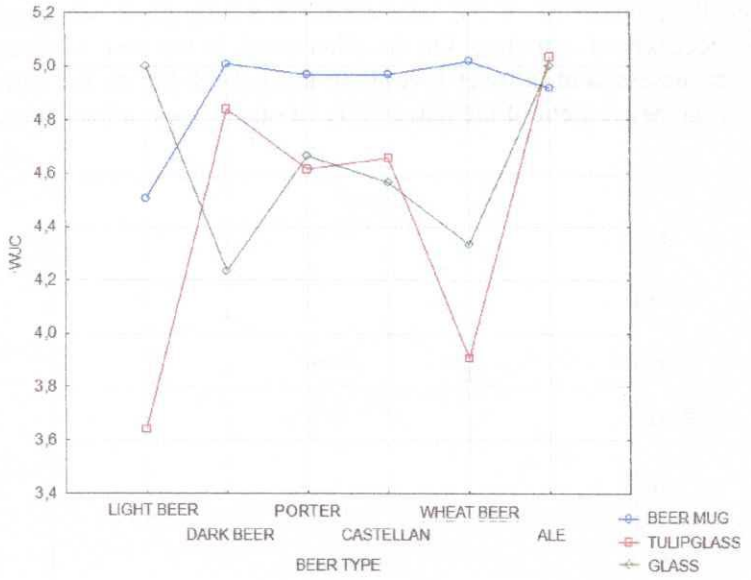

Figure 1. Organoleptic quality (WJC) of individual beer types assessed in different vessels
Source: own study

3.2 Results of the assessment of organoleptic characteristics of the tested beers depending on the type of vessel

The taste of light beer served in a tulip glass was evaluated at a lower level than that of the same beer served in the other vessels. The type of vessel had no impact on the assessment of the taste of other types of beer (Figure 2).

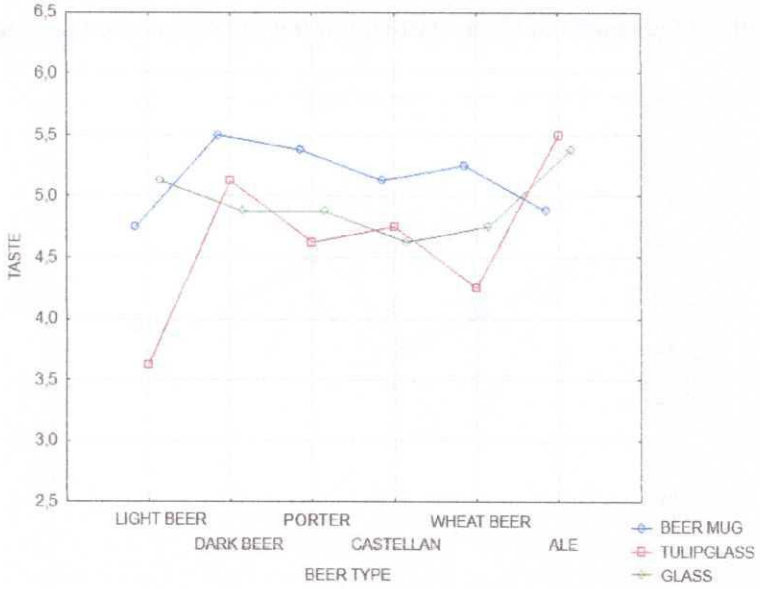

Figure 2. Taste of different types of beer evaluated in different vessels
Source: own study

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In the case of light beer, the palatability of this beer served in a tulip glass was assessed at a lower level than the palatability of the same beer served in a glass. On the other hand, in the case of wheat beer, the palatability of this beer served in a mug was assessed at a lower level than the palatability of the same beer served in a mug. The vessel type did not affect the assessment of the palatability of other types of beer (Figure 3).

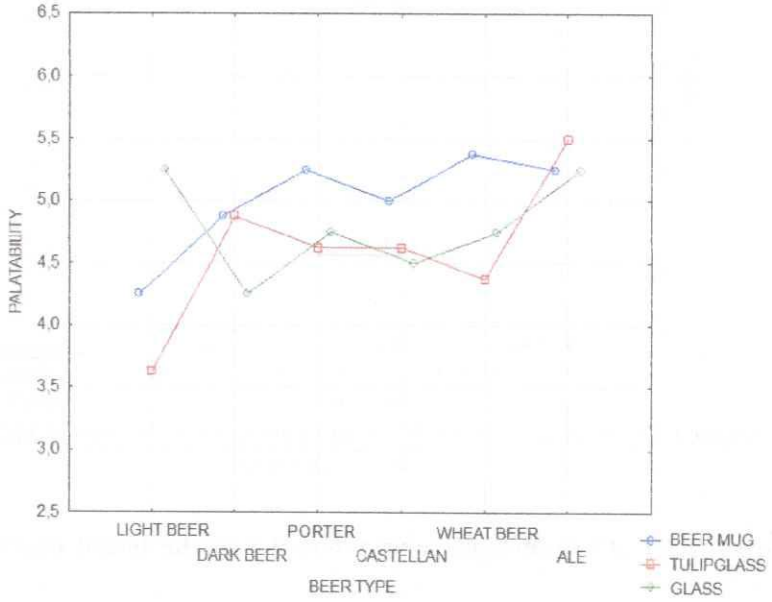

Figure 3. The palatability of different types of beer evaluated in different vessels
Source: own study

The saturation of wheat beer served in a tulip glass was assessed at a lower level than beer served in a mug. The type of vessel did not affect the results of the assessment of the saturation of other types of beer (Figure 4).

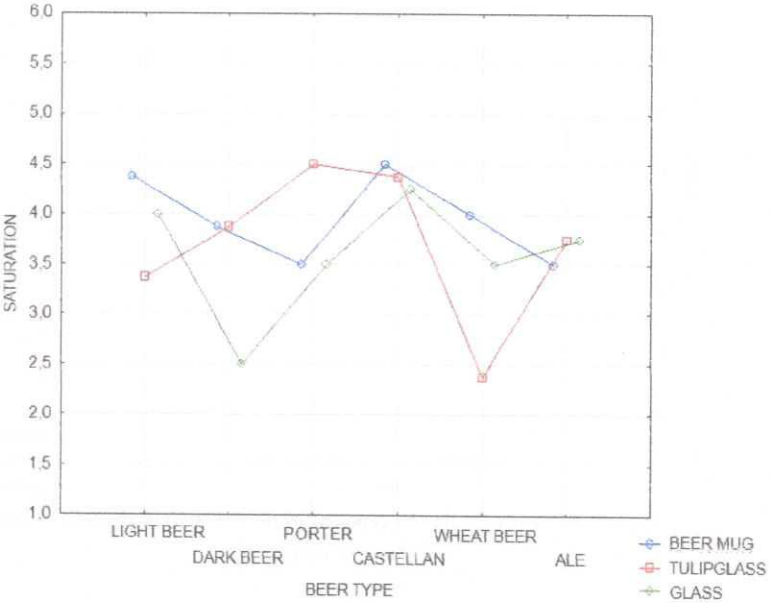

Figure 4. Saturation of different types of beer evaluated in different vessels
Source: own study

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The bitterness of a light beer served in a tulip glass was rated lower than beer served in a mug and a glass. The type of vessel had no impact on the results of the bitterness evaluation of other types of beer (Figure 5).

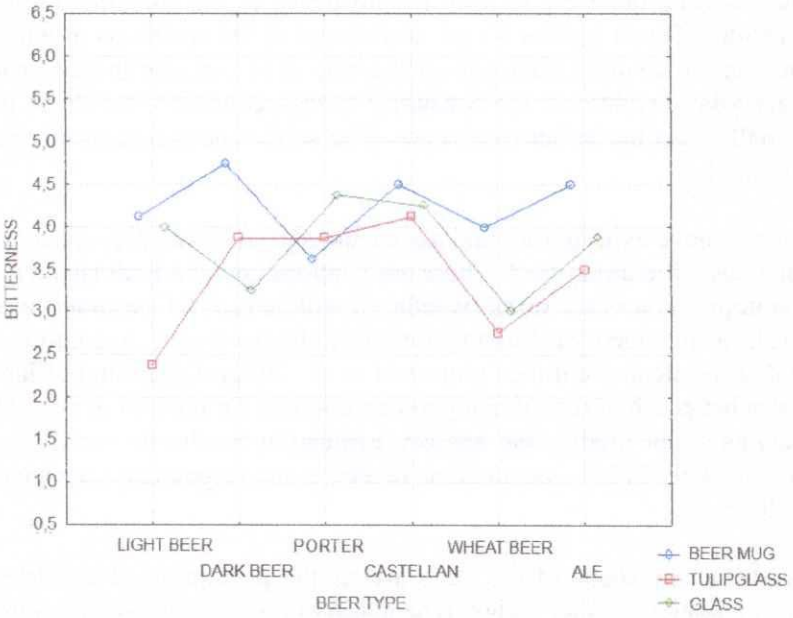

Figure 5. Bitterness of different types of beer evaluated in different vessels
Source: own study

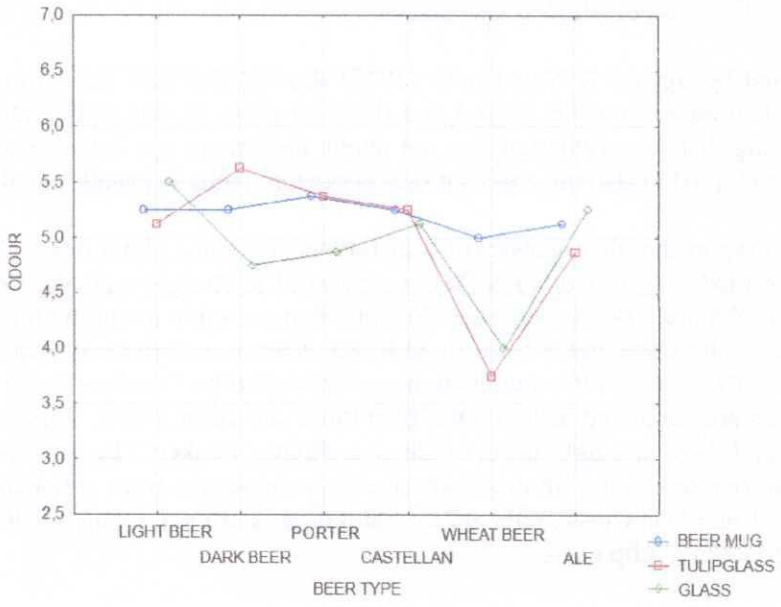

Figure 6. The odour of different types of beer evaluated in different vessels
Source: own study

The type of vessel had no statistically confirmed effect on the results of the odour assessment of any beer (see Figure 6 above).

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Conclusions

Many sensory evaluation methods serve samples in identical containers with the most "neutral" appearance possible. This procedure is used precisely to limit the influence of the container's appearance on the evaluation results. However, the results of such studies do not correspond to the situations in which beer is consumed every day. Therefore, It is justified to conduct studies in such a way as to consider the influence of glass on taste values because in "normal" everyday conditions, the consumer always consumes the drink in some container, and the form of this container will affect his or her experience. The studies described in this publication were conducted with this assumption in mind.

It turns out that respondents have expectations and associations even before they touch the glass in which the drink is served and before they taste the drink itself. These associations concern both taste values (bitterness, sweetness, acidity) and the general impression of the drink (whether it will be tasty). Consumers also tend to associate glasses with straight vertical walls as intended for drinking non-alcoholic beverages. In contrast, glasses with sloping walls are associated as intended for alcoholic drinks (Attwood et al., 2012). Other studies have shown that respondents claim that the drink tastes better when served in a glass appropriate for it (Wan et al., 2015). It seems reasonable to assume that the associations can modify the sensory evaluation results the assessors have before starting the evaluation (Casales-Garcia et al., 2023). Associations related to the respondent's personal life experiences will also be crucial (Wan et al., 2015).

It is commonly believed that the shape of the glass affects the perception of the drink's aroma. Glassware that widens upwards (such as a goblet or other "tulip" type glass) allows aromas to concentrate at the top, allowing for a fuller experience of rich aromas. Narrow, tall glasses, such as those for wheat beer, help maintain the foam, which retains the aromatic substances. However, these principles were not confirmed in the studies that were conducted. The results did not indicate statistically significant differences between the perception of the beer's aroma and the shape of the glass in which it was assessed.

The research conducted by Spence & Van Doorn (2017) showed that beer served in a mug was rated higher in terms of appearance than the same drink served in a different glass. In this study, beer served in a mug was also rated higher, considering that the evaluation was not about appearance but about tastiness. The conclusions from the research of Wan et al. (2015) also indicate that beer served in a mug is usually rated higher.

The same authors also report that the intensity of beer flavour was rated about 6% higher when participants tasted beers from a curved-walled vessel than when they were served in straight-walled vessels. In this study, however, the opposite result was obtained. Beers were rated higher when served in a mug with traditional straight walls with a handle. In most cases, the same beers were rated lower when tasted from an oval-shaped glass and a goblet. Results similar to those described in this publication were obtained by Casales-Garcia et al. (2023). They indicate that beers in a tall glass are perceived as less bitter than those served in a mug. This study also observed a similar relationship between dark beer and light beer, which was slightly weaker. The same authors also prove that beers served in tulip glass were rated higher. In this study, the opposite results were obtained – beer served in tulip glass is usually rated lower. Light beers' taste, palatability, saturation, and total quality (WJC) were especially evaluated when this beer was served in a tulip glass.

On the other hand, a significant variation in palatability and saturation was noted for wheat beer, depending on the type of vessel. No statistically significant differences in their parameters were recorded for the remaining beers depending on the type of vessel.

The results obtained in this study indicate that the sensory characteristics of beers were rated lower than those of other authors. In the case of light beer, differences in the ratings of taste, palatability and bitterness were noted

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depending on the type of vessel in which they were served. In the case of wheat beer, differences in the ratings of palatability and saturation were noted.

The conducted research expands the current knowledge on the influence of the vessel's shape on the experience of drinking beer. It should be noted, however, that there is still much to be discovered in this area. The brewing industry and the glass industry are aware of the different requirements of modern consumers.

Therefore, they undertake activities related to introducing various new types of beer and different types of glass. These activities are related to the desire to stand out in the market and offer customers new, original products. However, such a large number of types of beer available on the market and an equally large number of different types of glass available means that there can be dozens or even hundreds of possible interactions between these products. Both customers and manufacturers should be aware of the relationships between individual products, as these relationships affect the use of material, production volume and consumption. In today's sustainable world, it's critical not to make purchases of things that aren't needed. Consumers who know the relationship between the characteristics of glass and beverage can make more informed and thoughtful purchases. They should buy glassware that best suits the drinks they consume.

On the other hand, manufacturers have more opportunities to offer products that will suit their customers. However, this study has some limitations. This study examined how the shape of the glass affects the drinker's perception. The thickness of the wall of the product is also a parameter that affects perception. The wall directly touches the mouth of the drinker. Therefore, it can affect its perception. It would be interesting to study how the vessel wall's thickness affects the drinker's perception. In this study, undecorated products were used. It is worth checking how decorations on the glass (for example, beer brands) affect the drinker's perception. This fact means that opportunities for new research on how different types of beer and different types of glass interact are constantly emerging.

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Damian DUBIS
ORCID ID: https://orcid.org/0000-0001-6054-4729

Jolanta BARAN
ORCID ID: https://orcid.org/0000-0002-2361-9151