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# Can the concept of dark kitchen compete with an ordinary restaurant in Portugal?

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Dissertation

presented as partial requirements for obtaining the degree of Master in Statistics and Information Management

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# CAN THE CONCEPT OF DARK KITCHEN COMPETE WITH AN ORDINARY RESTAURANT IN PORTUGAL?

by

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Dissertation presented as partial requirements for obtaining the degree of Master in Statistics and Information Management, specialization in Marketing Research and CRM

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# DECLARATION OF INTEGRITY

I declare that I have carried out the present academic work with integrity. I confirm that I have not resorted to the practice of plagiarism or any other form of misuse of information or falsification of results during the process of preparation of this work. I also declare that I am aware of the Rules of Conduct and the Code of Honour of NOVA Information Management School.

*[Yulia Dyachenko]*

*[Lisboa, November 2022]*

# ABSTRACT

This study aims to understand if the dark kitchen concept (a fully equipped place with all needed in a kitchen but without dining space for customers) can compete with an ordinary restaurant in Portugal. As Portugal is among the top 10 European countries that spend more on Eating out while the term dark kitchen still needs to be discovered, these two facts may be an obstacle to developing the new concept in Portugal. To verify this, an online experiment conducted to compare consumers' attitudes and opinions on dark kitchens versus restaurants. One of the main conclusions that can be drawn from this study is that there is a need to broadcast information to customers and tell them what a dark kitchen is, as the group more aware of the dark kitchen was more loyal to the service.



# KEYWORDS

Restaurant; Online delivery service; Dark kitchen; Willingness to pay; Delivery, Portugal

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# 1. INTRODUCTION

Portugal is full of restaurants. In 2018 there were 31,363 restaurants in Portugal, which is 11% higher compared to 2014 (Report et al., 2021). Portugal is on the list of the top 10 European countries whose residents spend more on eating out (Statista, 2018).

In 2020, the whole world faced the new reality of the Covid-19 pandemic. All our ordinary life has changed – remote work, closed borders, closed services, including restaurants. Many restaurants were closed during the pandemic, and Portugal is no exception. Around 40% of restaurants in Portugal filed for bankruptcy (Report et al., 2021).

From customers' perspective – people are forced to buy products in supermarkets and cook at home or to use online food delivery services, such as Glovo, Uber Eats, Bolt Food, and similar. From a business perspective – restaurants tried to survive by changing their business model, organizing delivery, or using external online services to deliver their product. The problem is that if these costs had not been considered in the business model, the restaurant would most likely not survive.

One of the latest restaurant trends in the world is the dark kitchen or ghost kitchen. Both expressions have the same meaning: a place fully equipped with all needed in a kitchen but without dining space for customers. It could be one specific restaurant or set of them, like a food market, where different restaurants can prepare a meal for delivery or takeout.

The main research question is: Will people living in Portugal accept such a new restaurant concept as a dark kitchen?

Dark kitchens could be a 1$ trillion business by 2030 (Euromonitor, 2019). Now in Portugal, a few companies are proposing this concept. In the same way that, in the last five years, third-party delivery has helped to define the restaurant industry, the next stage of that evolution over the next five years is going to be dark kitchens. The dark kitchen model has become more popular among consumers and restaurant owners. However, there is some mistrust about food quality and conditions where and how food is prepared (Darekar, Shende, Shaikh, 2020). On the other hand, dining out is as much a social activity as anything else (Spang, 2000; Julier, 2013; Spence, 2017a). Also, the dining atmosphere significantly affects customers' positive and negative emotions and perceived value (Yinghua, SooCheong, 2009).

If we look at search trends, demand for food delivery has grown since the pandemic started (Figure 1). Now it is close to 2019 when the pandemic has yet to start.

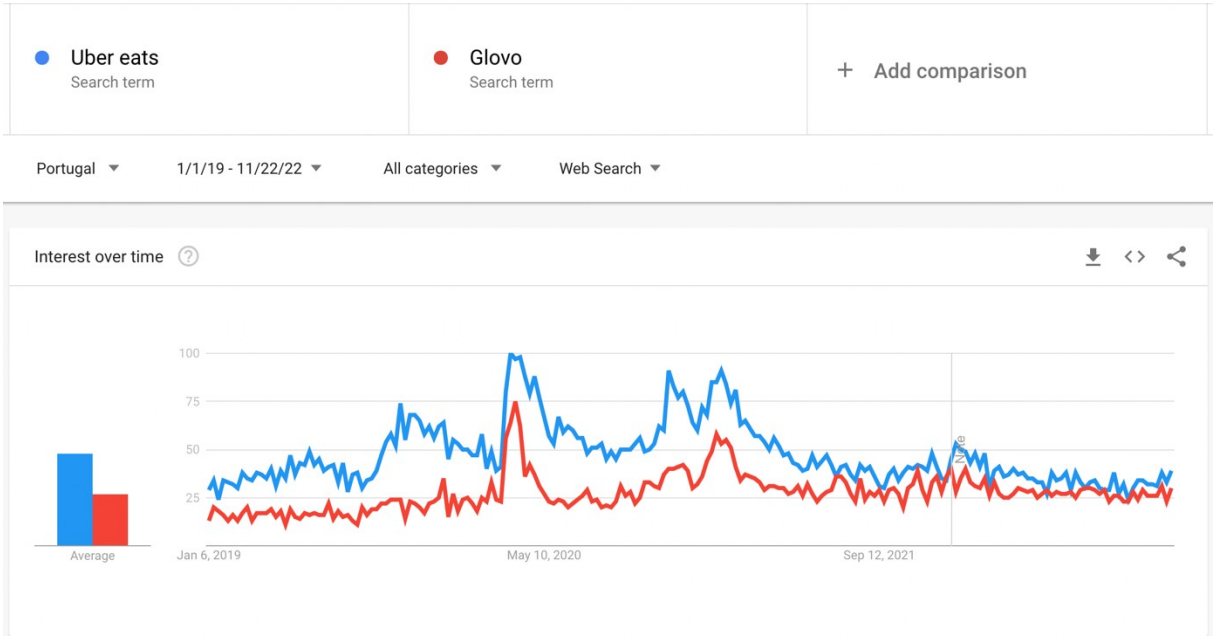


Figure 1. Comparison of searches of most popular food delivery companies in Portugal for the three years (before and during the Covid-19 pandemic)

At the same time, demand for restaurants fell during the pandemic but raised when restrictions were canceled (Figure 2). It can be assumed that as soon as the restrictions associated with the Covid-19 pandemic are over, the demand for food delivery in Portugal will decrease, and for restaurants, it will increase.

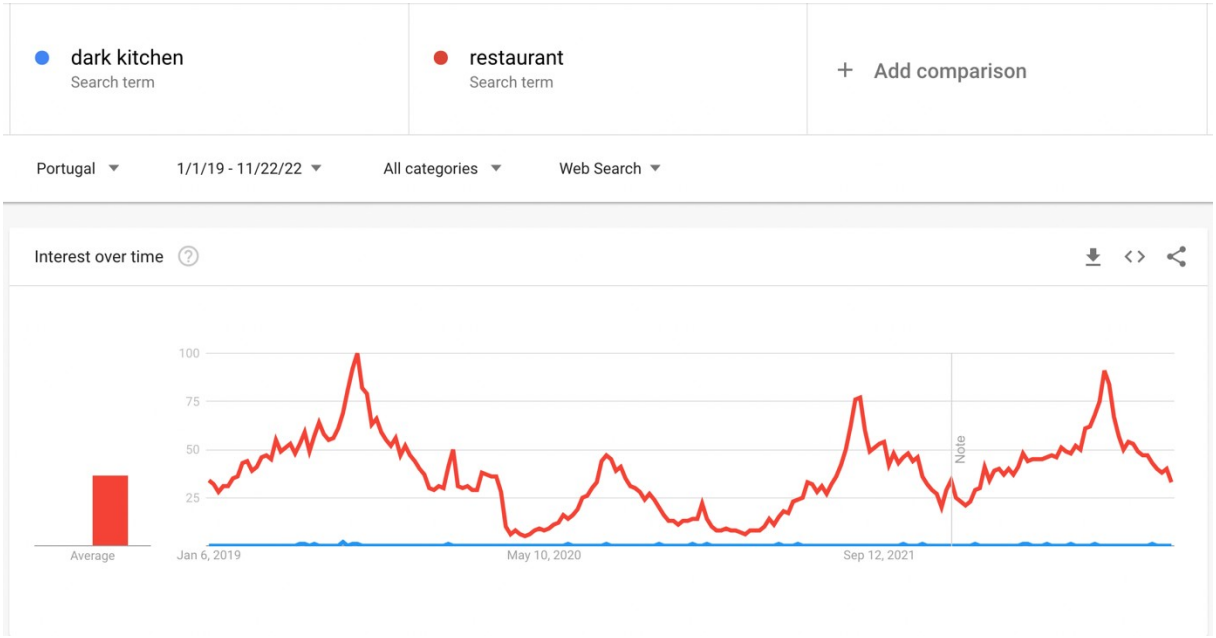


Figure 2. Searches of dark kitchens and restaurants in Portugal for the three years (before and during the Covid-19 pandemic)

As shown in Figure 2, demand for dark kitchens is much lower than that for a restaurant, which may be due to a lack of interest in the concept, lack of information about it, or some other reason. This study will allow us to know more

about attitudes toward a new type of restaurant business in the context of Portugal.

We conducted an online experiment with adult consumers living in Portugal and familiar with delivery services (e.g., Glovo, Uber Eats, Bolt food), visiting restaurants, and hypothesized that individual's willingness to pay would be higher for the usual restaurants versus the dark kitchen. We also hypothesized that trust in the quality of the typical restaurant is higher, compared to the dark kitchen restaurant, due to the lack of transparency and the lack of contact with the dark kitchen staff.

To our knowledge, no previous study has been conducted to identify the needs and concerns of the people of Portugal regarding the new concept of dark kitchens that are becoming relevant for business owners and customers during and after the Covid-19 pandemic.

This study aims to identify the attitude of the people living in Portugal towards the new concept of a dark kitchen and to answer whether it can compete with an ordinary restaurant. The following pages will provide information about theoretical background and previous research on dark kitchens, willingness to pay, and what is essential for people from a customer perspective in the restaurant industry.

# 2. LITERATURE REVIEW

## 2.1. DARK KITCHEN

One of the new trends – dark kitchen nowadays has two models: one model is when a fully equipped kitchen is rented and usually shared, also called "hubs," and the second is when it is a restaurant that does not have dining space (Anon, 2020). The main advantage of both dark kitchen models is that they can reduce production costs. During the Covid-19 pandemic, this concept is relevant to the market needs and restrictions people have (Volpe, 2020). One of the pandemic's consequences is the fear of contracting covid from visiting restaurants (Hakim et al., 2021). This fear opens up new possibilities for the concept of a dark kitchen. It also creates an enabling environment to create and promote online services that can function effectively in different circumstances (Restaurant Owner, 2020). Another advantage is the difference in the cost of opening a dark kitchen. For comparison, one estimate is that it costs around $475,500 to open a full restaurant in the US while opening a dark kitchen could cost around $150,500 (Restaurant Owner, 2020). The dark kitchen restaurant can also be based at home, taking over the main operational activities (Reuschke&Mason, 2022).

One of the latest studies about dark kitchens explores a connection between the perceived benefits and risks of dark kitchens with consumers' trust and intentions (Cai, Leung, and Chi, 2022).

According to this study, personal (e.g., taste, quality, value for money) and social benefits (e.g., worker well-being, local economy, public health) positively influence trust, which positively affects consumers' behavioral intentions. At the same time, social risks (e.g., hygiene, cleanliness, and food sources) undermine trust.

This study highlights the importance of creating a positive image of the dark kitchen.

Recently, more research has begun to emerge that attempts to explain consumer behavior regarding dark kitchens, especially in the post-pandemic period. Despite all the research which have been made about the dark kitchen, online delivery services, and consumer behavior (e.g., Cai and Leung, 2020; Gunden, Morosan, and DeFranco, 2020; Yang et al., 2021), there still needs to be more information regarding the possible acceptance of this concept by consumers, especially in Portugal.

Statistics for 2018 (Statista, 2018) place Portugal among the top 10 European countries that spend more on Eating out (Figure 3).

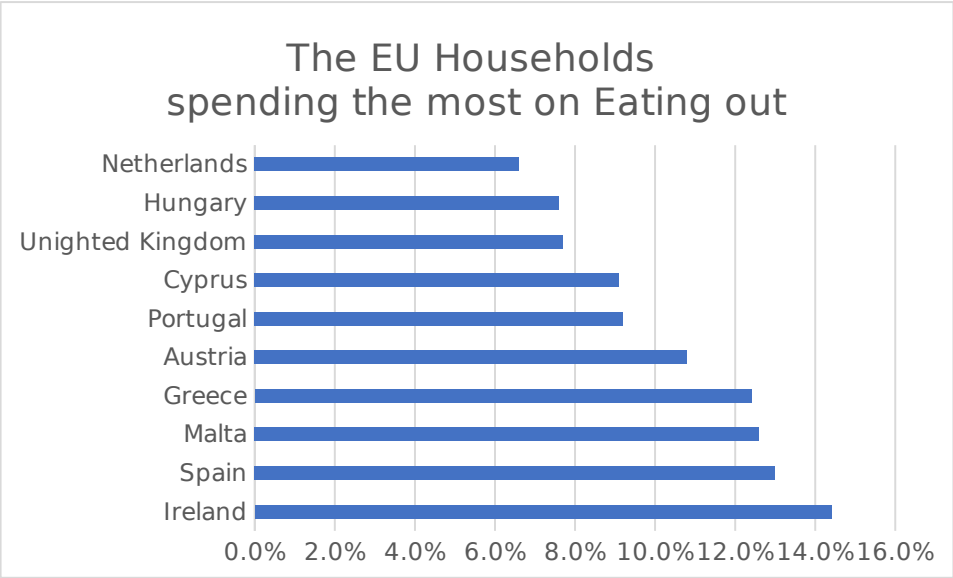


Figure 3. The EU Households spending the most on Eating out

65% of Portuguese people prefer to eat out at least once a month, from which we can conclude that eating out is a habit for Portuguese people, and it plays an essential part in their lives (Nielsen, 2016). Consequently, it can be assumed that the proliferation of dark kitchens in Portugal may have some difficulties.

Based on this, the following hypothesis was formulated:

*H1. People in Portugal prefer a usual restaurant rather than a dark kitchen.*

## 2.2. Willingness to pay

Willingness to pay is the maximum price the customer is ready to pay for a product or service (Krishna, 1991; Wertenbroch & Skiera, 2002). To evaluate willingness to pay in surveys, there are two methods – direct and indirect. In the indirect method, the customer is prompted to choose one of the options, and then the results are scored by econometric procedures (Schmidt & Bijmolt, 2020). For this study was chosen the direct method which means that the customer was asked to give a price that he is ready to pay for the product. In this study, a customer was prompted to enter the price for a burger in euros. We wanted to determine if there would be any difference between willingness to pay among respondents, divided into two groups – conditions.

Willingness to pay plays an essential role in the context of a restaurant, as it is an indicator of customer satisfaction and loyalty (Carson, 2008). Since customer satisfaction has a strong positive impact on willingness to pay (Homburg et al., 2005), identifying the willingness to pay for a service is one of the main factors in determining whether to open a restaurant or launch any other service. It allows companies to plan budgets, determine prices, form special offers for customers and be an efficient business. Therefore, willingness to pay is accepted as one of

the main factors in the restaurant industry for business development and market share (Dutta et al., 2014).

The term “dark kitchen” is not well-known yet (Hakim et al., 2022), which may influence the willingness to pay and the choice between an ordinary restaurant and a dark kitchen. Since millennials dine out relatively more often than any other generation, and because gastronomy occupies a considerable place in their lives, they spend more on eating out (Apresley, 2010). *Also, the youngest people are more familiar with technologies, with new trends, and it may affect that they know more about such a concept as a dark kitchen, which can influence their willingness to pay.*

One recent study on dark kitchens found that the willingness to pay increases if customer awareness of the restaurant and the delivery service increases, which can be achieved by having positive reviews (Hakim et al., 2022). As we found out earlier, dark kitchens are not a widespread and well-known type of restaurant, hence we suggested that the willingness to pay for this type of restaurant would be lower than that of a regular restaurant. Based on this, the next hypothesis was formulated:

*H2. The willingness to pay in a usual restaurant is higher than in a dark kitchen.*

*H3. Customers believe that food from a dark kitchen should cost less.*

*H4. Age negatively affects the willingness to pay for food from a dark kitchen.*

*H5. Income positively affects the willingness to pay for food from a dark kitchen.*

## 2.3. Food quality

Food is the main product of a restaurant. The most crucial thing in a restaurant is the quality of the food. The dining experience is directly connected with food quality, an attribute that affects customer behavioral intentions regarding restaurant dining (Namkung & Jang, 2007; Sulek & Hensley, 2004). Food quality was studied previously: it was confirmed that the main factor that defines the choice of visiting a restaurant from a customer’s point of view is food quality (Susskind & Chan, 2000). Food quality was defined as the main factor which affects consumer satisfaction during the food buying process (Mathayomchan & Taecharungroj, 2020). Another study determined food quality as a leading factor that predicts customer loyalty in casual-dining restaurants (Mattila, 2001). From the customer’s perspective, food quality is the main factor ahead of even service quality (Sulek & Hensley, 2004). Research by National Restaurant Association confirmed that food quality is the most crucial customer demand when choosing a restaurant.

Many restaurants followed a new trend - open kitchens, which became part of the dining experience and increased the level of trust in the quality of food and cooking conditions because the chef's work is visible (Alonso & O'Neill, 2010;

Byun & Jang, 2018; Sohn & Lee, 2018). The opposite trend is a dark kitchen, also called a ghost or virtual kitchen. The main difference between a usual restaurant and a dark kitchen is that there is no dining space (Volpe, 2020), and food produces only for delivery or takeout. Since the concept of a dark kitchen has yet to be well-known, it has been reported that 72% of customers prefer to order food from usual restaurants (Anon, 2021). This leads us to the following hypothesis:

*H6. Customers' trust in food quality is higher in a restaurant with physical dining than in a dark kitchen.*

## 2.4. SERVICE QUALITY

The second important factor in the dining experience is service quality. This aspect was very well studied in the marketing area. Usually, there are two perspectives: a complex construct created by evaluating aspect performance (Parasuraman et al., 1988) and the customer's cognitive rating of the service provided (Taylor & Baker, 1994). *Service quality* is usually defined as the overall experience of service by the customer (Zeithaml, 1988). So, service quality is defined by a gap between consumers' subjective expectations and received experience (Bolton & Drew, 1991; Parasuraman et al., 1985, 1988). On the strength of this theory, Parasuraman et al. (1988) created SERVQUAL as a tool to measure service quality. SERVQUAL includes five dimensions: reliability, responsiveness, empathy, assurance, and tangibles. Many studies used SERVQUAL to measure service quality in service-related situations (Caruana et al., 2000; Lee & Lambert, 2000).

Previous literature confirmed that dining out is as much a social activity as anything else (Spang, 2000; Julier, 2013; Spence, 2017a). Also, the dining atmosphere significantly affected customers' positive emotions, negative emotions, and perceived value (Yinghua L., SooCheong J., 2009). The most important aspect of a restaurant is the customer's assessment of the quality of the restaurant. If we look at the definition of the term experience, we can see that it includes knowing, observing, or interacting with objects. Similarly, the customer's impression of the restaurant is formed, which is formed during lunch or dinner. When forming an impression, the client compares his current experience and expectations based on his experience. This is similar to the assessment of perceived service quality (Parasuraman et al., 1988; Zeithaml & Bitner, 2000).

According to another study, one of the most important factors by which customers rate their dining experience is the quality of service (Wong & Fong, 2010; Yasin & Yavas, 2001). The whole process of providing service is essential: in a usual restaurant, from entering the restaurant until leaving, and in a dark kitchen, from making an order until receiving it. Hence, the quality of interaction between consumers and restaurants is the main factor determining the received perception of service and post-consumption behaviors (Brady & Robertson, 2001). Since in usual restaurants, the interaction with the clients and the service

both take place directly in the dining area (unlike in dark kitchens), the following hypothesis was formulated:

*H7. Customers' confidence in the quality of the restaurants is higher for those with a dining space.*

## 2.5. Theoretical model

According to the hypothesis and research questions, the following theoretical model was developed in which condition (restaurant or dark kitchen) is the independent variable. As dependent variables were chosen: willingness to pay, trust in good cooking conditions, trust in high quality of products, trust in team professionalism, confidence in compliance with sanitary standards, trust in problem-solving, visiting a restaurant is a social activity and confidence in the quality of the restaurant. We also added moderators to the model, which are age and income. The detailed theoretical model is depicted in Figure 4.

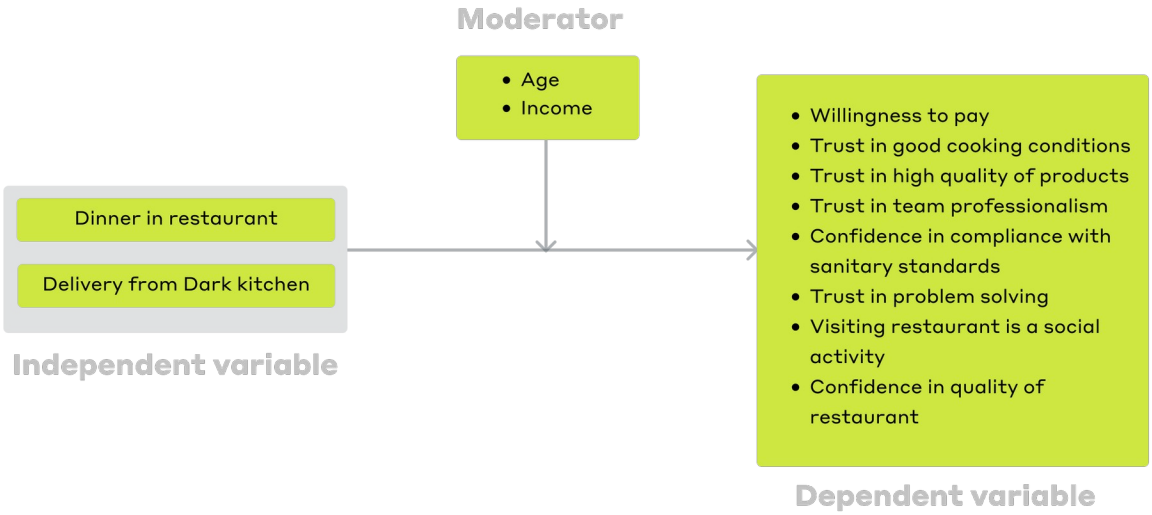


Figure 4. Theoretical model

# 3. METHODOLOGY

For this research, an experiment with two conditions was conducted. The experiment was set up in Qualtrics, and all results were analyzed using SPSS. It was decided to conduct a pre-test to fine-tune the hypotheses and the questionnaire.

The first section of the survey contained questions that helped to determine the further sample. For this study, it is crucial to choose people who live in Portugal and have recent experience with delivery services and restaurants. To verify that, three questions were asked: “Did you visit restaurants in the last six months?”, “Did you use one of the delivery services like Uber Eats, Glovo, Bolt Food, or similar, in the last six months?” and “Do you live in Portugal for the past six months?”

After that, all respondents who answered positively to the first three questions were divided into two samples randomly. One sample saw a group of questions related to a usual restaurant, and the second sample saw the same questions related to a dark kitchen.

Most of the question items used in this study were measured on a 5-point Likert-type scale (1 = strongly disagree and 5 = strongly agree). The questions were regarding the cooking conditions, the professionalism of the team, the quality of the products used, sanitary standards, and problems solving. To explore willingness to pay in this study, a burger photo was shown, and respondents were asked to indicate the price in euros (€) they were willing to pay. On this, the experimental part was completed.

The next part of the survey was the same for all participants. It contained questions about the perception of the restaurant as a social activity, the choice between a restaurant, and delivery from the dark kitchen in the presence or absence of time. Further, it was asked to indicate the amount of time participants were willing to spend on the road to the restaurant and waiting for delivery from the dark kitchen. A block followed this with demographic questions such as gender, age, average income, education level, marital status, and having or not having children. The survey included 17 questions and took approximately three to five minutes for participants to complete. The full questionnaire was added to the “Survey”.

After the pre-test, it was decided to use the same questionnaire for the main study based on the results. Data collection was conducted between January 2022 and June 2022.

## 3.1. MAIN STUDY

One hundred two participants took part in both parts of the study – in pre-test and main study. First, three variables were tested sequentially, which determined the further sample. These variables were: living in Portugal, using one of the delivery services (like Uber Eats, Glovo, Bolt Food, or similar), and visiting a

restaurant in the last six months. After checking frequencies, it was found that 99 participants visited a restaurant, 65 participants used one of the delivery services, and 64 participants lived in Portugal during the last six months (Figure 5).

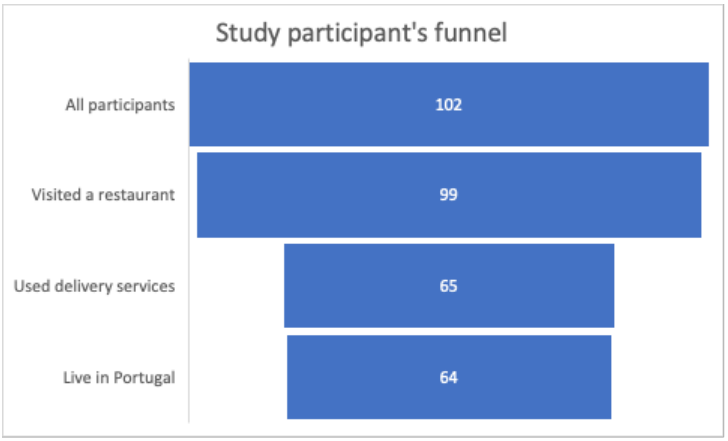


Figure 5. Study participant's funnel

The main characteristics of the sample:

- The average age of participants was 37.79 years (SD = 10.83 (Figure 6)).

**Descriptive Statistics**

| | N | Mean | Std. Deviation |
|---|---|---|---|
| What is your age? | 58 | 37.7931 | 10.83004 |
| Valid N (listwise) | 58 | | |

Figure 6. The average age

- By gender, participants were distributed as follows: 28% were male, and 72% – were female.
- By education level, participants were distributed as follows: Básico ou Secundário – 5%, Superior – 17%, Licenciatura – 36%, Mestrado – 42% of participants.

- By the family status distribution is the following: 65% of people are married, 25% are single, and 10% are divorced.

We started with hypothesis *H1. People living in Portugal prefer the usual restaurant rather than a dark kitchen*. To verify this, we have asked if, in some circumstances, customers would prefer a restaurant or dark kitchen. To verify this, we ran a one-way ANOVA with the restaurant and dark kitchen condition as independent variable and time spent on the road to the restaurant versus time waiting for delivery as the dependent. As a result, we found an effect on time spent on the road to the restaurant versus time waiting for delivery between two conditions. In dark kitchen condition M = 3.38, in restaurant condition M = 2.59, F (1,56) = 6.56, p = 0.013 (Figure 7).

**Tests of Between-Subjects Effects**

Dependent Variable: Imagine that the closest restaurant with dining space is 40-min a

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 9.121[a] | 1 | 9.121 | 6.560 | .013 |
| Intercept | 516.017 | 1 | 516.017 | 371.130 | <.001 |
| Condition | 9.121 | 1 | 9.121 | 6.560 | .013 |
| Error | 77.862 | 56 | 1.390 | | |
| Total | 603.000 | 58 | | | |
| Corrected Total | 86.983 | 57 | | | |

a. R Squared = .105 (Adjusted R Squared = .089)

**Estimated Marginal Means**

**1. Grand Mean**

Dependent Variable: Imagine that the closest restaurant with dining space is 40-min a

| Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|
| | | Lower Bound | Upper Bound |
| 2.983 | .155 | 2.673 | 3.293 |

**Estimates**

Dependent Variable: Imagine that the closest restaurant with dining space is 40-min away. Delive

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| dark kitchen | 3.379 | .219 | 2.941 | 3.818 |
| restaurant | 2.586 | .219 | 2.148 | 3.025 |

Figure 7. ANOVA results for DV if restaurant is far then prefer dark kitchen

It means that people in dark kitchen condition are more likely to choose delivery from a dark kitchen than those from a restaurant.

Next, we checked the *H2. The willingness to pay in the usual restaurant is higher than in dark kitchens*. To verify this hypothesis, we ran a one-way ANOVA with restaurant or dark kitchen condition as the independent variable and burger price as the dependent variable. As a result, we found no effect on willingness to pay between the two conditions. In dark kitchen condition M = 9.69, in restaurant condition M = 10.38, F (1,56) = 0.76, p = 0.39 (Figure 8).

**Tests of Between-Subjects Effects**

Dependent Variable: Burger_price

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 6.897[a] | 1 | 6.897 | .756 | .388 |
| Intercept | 5840.069 | 1 | 5840.069 | 639.964 | <.001 |
| Condition | 6.897 | 1 | 6.897 | .756 | .388 |
| Error | 511.034 | 56 | 9.126 | | |
| Total | 6358.000 | 58 | | | |
| Corrected Total | 517.931 | 57 | | | |

a. R Squared = .013 (Adjusted R Squared = -.004)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Burger_price

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|
| dark kitchen | 9.690 | .561 | 8.566 | 10.813 |
| restaurant | 10.379 | .561 | 9.256 | 11.503 |

Figure 8. ANOVA results for DV burger price (willingness to pay)

Hence, *H2. The willingness to pay in a usual restaurant is higher than in a dark kitchen* was rejected, which means there is no difference between the two conditions in the willingness to pay. From a business perspective, this suggests that there is no clear indication that the willingness to pay in a dark kitchen restaurant is lower than in a regular restaurant, which opens opportunities for a dark kitchen.

Then we checked *H3. Customers believe that food from the dark kitchen should cost less*. We ran a one-way ANOVA with restaurant and dark kitchen condition as the independent variable and attitude to price as the dependent variable. As a result, we found no effect on attitude toward the cost of food between the two conditions. In the dark kitchen condition M = 3.62, in the restaurant condition M = 3.21, F (1,56) = 2.06, p = 0.16 (Figure 9).

**Tests of Between-Subjects Effects**

Dependent Variable: Tell us what do you think about statements below. - I believe tha

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 2.483[a] | 1 | 2.483 | 2.057 | .157 |
| Intercept | 675.931 | 1 | 675.931 | 560.057 | <.001 |
| Condition | 2.483 | 1 | 2.483 | 2.057 | .157 |
| Error | 67.586 | 56 | 1.207 | | |
| Total | 746.000 | 58 | | | |
| Corrected Total | 70.069 | 57 | | | |

a. R Squared = .035 (Adjusted R Squared = .018)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Tell us what do you think about statements below. - I believe tha

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|
| dark kitchen | 3.621 | .204 | 3.212 | 4.029 |
| restaurant | 3.207 | .204 | 2.798 | 3.616 |

Figure 9. ANOVA results for DV attitude to price

From a business perspective, this result could mean that customers perceive the dark kitchen as a full-fledged restaurant and are willing to pay for it equally.

Then we checked if there is moderating effect of age and willingness to pay as was formulated in *H4. Age negatively affects the willingness to pay for food from dark kitchen and H5. Income positively affects willingness to pay for a dark kitchen*, but this study found no effect.

The next step was to check the *H6. Customers' trust in food quality is higher in a restaurant with physical dining than in a dark kitchen.* and *H7. Customers' confidence in the quality of the restaurants is higher for those with a dining space*. We had five variables to measure the quality of the restaurant: trust in good cooking conditions, trust in the quality of food, trust in the professionalism of a team, trust in following sanitary standards, and trust in problem-solving. We ran a one-way ANOVA with restaurant and dark kitchen condition as an independent variable and those five variables - as a dependent, successively.

First, we ran a one-way ANOVA for restaurant and dark kitchen condition as the independent variable and trust in cooking conditions as the dependent variable. As a result, we found no effect on trust in cooking conditions between restaurant and dark kitchen conditions. In dark kitchen condition M = 3.5, in restaurant condition M = 3.5, F (1,56) = 0.00, p = 1.00 (Figure 10).

**Tests of Between-Subjects Effects**

Dependent Variable: Trust_cooking_condition

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 3.553E-14[a] | 1 | 3.553E-14 | .000 | 1.000 |
| Intercept | 717.517 | 1 | 717.517 | 711.385 | <.001 |
| Condition | .000 | 1 | .000 | .000 | 1.000 |
| Error | 56.483 | 56 | 1.009 | | |
| Total | 774.000 | 58 | | | |
| Corrected Total | 56.483 | 57 | | | |

a. R Squared = .000 (Adjusted R Squared = -.018)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Trust_cooking_condition

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|
| dark kitchen | 3.517 | .186 | 3.144 | 3.891 |
| restaurant | 3.517 | .186 | 3.144 | 3.891 |

Figure 10. ANOVA results for DV trust in good cooking conditions

Then we ran a one-way ANOVA with restaurant and dark kitchen condition as the independent variable and trust in problem-solving as the dependent variable. As

a result, we found no effect on trust in problem-solving between the two conditions. In dark kitchen condition M = 3.83, in restaurant condition M = 3.86, F (1,56) = 0.015, p = 0.9 (Figure 11).

**Tests of Between-Subjects Effects**

Dependent Variable: Trust_problem_solving

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | .017[a] | 1 | .017 | .015 | .902 |
| Intercept | 857.397 | 1 | 857.397 | 755.104 | <.001 |
| Condition | .017 | 1 | .017 | .015 | .902 |
| Error | 63.586 | 56 | 1.135 | | |
| Total | 921.000 | 58 | | | |
| Corrected Total | 63.603 | 57 | | | |

a. R Squared = .000 (Adjusted R Squared = -.018)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Trust_problem_solving

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| dark kitchen | 3.828 | .198 | 3.431 | 4.224 |
| restaurant | 3.862 | .198 | 3.466 | 4.258 |

Figure 11 ANOVA results for DV trust in problem solving

Then we ran a one-way ANOVA with restaurant and dark kitchen condition as the independent variable and trust in sanitary standards as the dependent variable. As a result, we found no effect on trust in sanitary standards between the two conditions. In dark kitchen condition M = 3.52, in restaurant condition M = 3.62, F (1,56) = 0.16, p = 0.69 (Figure 12).

**Tests of Between-Subjects Effects**

Dependent Variable: Trust_sanitary_standarts

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | .155[a] | 1 | .155 | .161 | .690 |
| Intercept | 738.776 | 1 | 738.776 | 765.161 | <.001 |
| Condition | .155 | 1 | .155 | .161 | .690 |
| Error | 54.069 | 56 | .966 | | |
| Total | 793.000 | 58 | | | |
| Corrected Total | 54.224 | 57 | | | |

a. R Squared = .003 (Adjusted R Squared = -.015)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Trust_sanitary_standarts

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| dark kitchen | 3.517 | .182 | 3.152 | 3.883 |
| restaurant | 3.621 | .182 | 3.255 | 3.986 |

Figure 12. ANOVA results for DV trust in sanitary standards

Next step - we ran a one-way ANOVA with restaurant and dark kitchen condition as the independent variable and trust in team professionalism as the dependent variable. As a result, we found no effect on trust in team professionalism between the two conditions. In dark kitchen condition M = 3.52, in restaurant condition M = 3.58, F (1,56) = 0.08, p = 0.78 (Figure 13).

**Tests of Between-Subjects Effects**

Dependent Variable: Trust_team_professionalism

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | .069[a] | 1 | .069 | .080 | .778 |
| Intercept | 731.655 | 1 | 731.655 | 848.720 | <.001 |
| Condition | .069 | 1 | .069 | .080 | .778 |
| Error | 48.276 | 56 | .862 | | |
| Total | 780.000 | 58 | | | |
| Corrected Total | 48.345 | 57 | | | |

a. R Squared = .001 (Adjusted R Squared = -.016)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Trust_team_professionalism

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| dark kitchen | 3.517 | .172 | 3.172 | 3.863 |
| restaurant | 3.586 | .172 | 3.241 | 3.932 |

Figure 13. ANOVA results for DV trust in team professionalism

Then we ran a one-way ANOVA with restaurant and dark kitchen condition as the independent variable and trust in food quality as the dependent variable. As a result, we found no effect on trust in food quality between the two conditions. In dark kitchen condition M = 3.55, in restaurant condition M = 3.86, F (1,56) = 1.84, p = 0.18 (Figure 14).

**Tests of Between-Subjects Effects**

Dependent Variable: Trust_quality_of_food

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 1.397[a] | 1 | 1.397 | 1.835 | .181 |
| Intercept | 796.983 | 1 | 796.983 | 1047.168 | <.001 |
| Condition | 1.397 | 1 | 1.397 | 1.835 | .181 |
| Error | 42.621 | 56 | .761 | | |
| Total | 841.000 | 58 | | | |
| Corrected Total | 44.017 | 57 | | | |

a. R Squared = .032 (Adjusted R Squared = .014)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Trust_quality_of_food

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| dark kitchen | 3.552 | .162 | 3.227 | 3.876 |
| restaurant | 3.862 | .162 | 3.538 | 4.187 |

Figure 14. ANOVA results for DV trust in the quality of food

The results of checking five variables, which measure the quality of the restaurant, are not significant, hence *H6. Customers' trust in food quality is higher in a restaurant with physical dining than in a dark kitchen* and *H7. Customers' confidence in the quality of the restaurants is higher for those with a dining space hypothesis* rejected. There is no difference between the two conditions regarding trust in the restaurant and the conditions for serving and preparing food there. This means there is no proof for assumptions that clients have distrust or doubts about the quality of the service provided at the dark kitchen, which, in turn, gives a dark kitchen a chance to develop in Portugal.

Next, we checked the assumption that attitudes towards going to a restaurant as a social activity may differ according to conditions. We ran a one-way ANOVA with restaurant and dark kitchen condition as the independent variable and visiting restaurants as a social activity as the dependent variable. As a result, we found no effect on attitudes towards going to a restaurant as a social activity between the two conditions. In dark kitchen condition M = 4.28, in restaurant condition M = 4.24, F (1,56) = 0.015, p = 0.90 (Figure 15).

**Tests of Between-Subjects Effects**

Dependent Variable: Tell us what do you think about statements below. - Visiting a re

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | .017[a] | 1 | .017 | .015 | .902 |
| Intercept | 1051.879 | 1 | 1051.879 | 933.471 | <.001 |
| Condition | .017 | 1 | .017 | .015 | .902 |
| Error | 63.103 | 56 | 1.127 | | |
| Total | 1115.000 | 58 | | | |
| Corrected Total | 63.121 | 57 | | | |

a. R Squared = .000 (Adjusted R Squared = -.018)

**Estimated Marginal Means**

**1. 1- Restaurant, o - Dark kitchen**

**Estimates**

Dependent Variable: Tell us what do you think about statements below. - Visiting a re

| 1- Restaurant, o - Dark kitchen | Mean | Std. Error | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|
| dark kitchen | 4.276 | .197 | 3.881 | 4.671 |
| restaurant | 4.241 | .197 | 3.846 | 4.636 |

Figure 15. ANOVA results for DV visiting restaurant is a social activity

Next, we continued to check other variables to find some insights.

Then we compared the time participants were willing to spend waiting for delivery from the dark kitchen and road to the restaurant and found a fascinating insight - the direction of the answers is different in two conditions. For instance, in the dark kitchen condition, participants were ready to wait longer for delivery from the dark kitchen than to spend time on the road to the restaurant. While in the restaurant condition group, participants were ready to spend more time on the road to a restaurant (Figure 16).

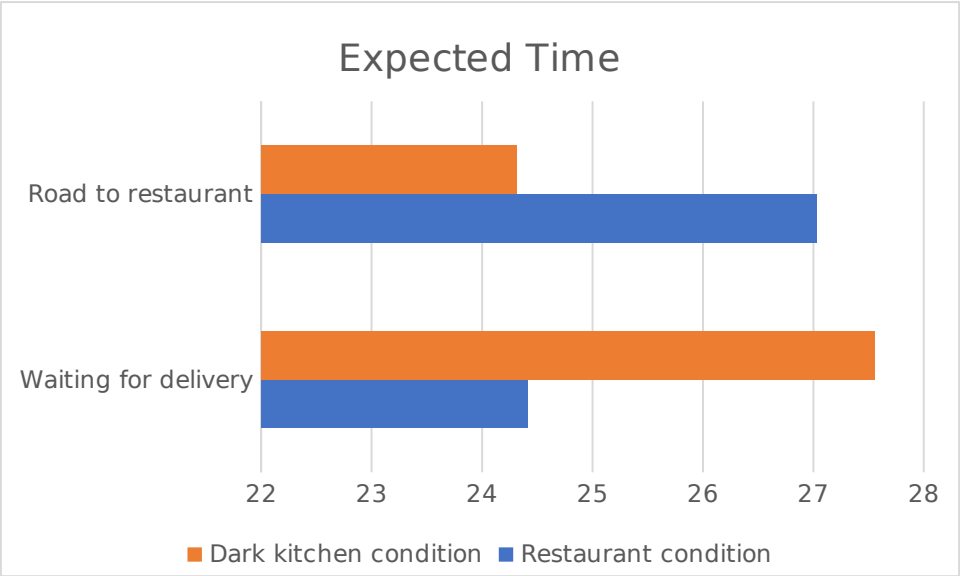


Figure 16. Expected time waiting for delivery and time to the road to a restaurant

# 4. DISCUSSION AND CONCLUSIONS

This study’s objective was to understand if the dark kitchen concept can compete with an ordinary restaurant in Portugal. To verify this was decided to run an experiment and compare results between two condition groups - restaurant and dark kitchen. According to previous research, customers have doubts about the food quality and the conditions where it has been prepared (Darker et al., 2020). Based on that, trust was chosen as one of the primary dependent variables. Also, willingness to pay was chosen, as it is one of the most important indicators for business, particularly those in the restaurant industry, as it shows customer satisfaction and loyalty (Carson, 2008). Another critical factor in the restaurant sphere is service quality.

However, dining out is a social activity, and the dining experience can only be replaced by food delivery if the restaurant's atmosphere is reunited. The atmospherics, which has been well explored before and was described by Kotler (1973) as "the effort to design buying environments to produce specific emotional effects in the buyer that enhance his purchase probability." Later, the atmospherics model was developed (Mehrabian A., Russell J., 1974), which suggests that the physical environment evokes positive or negative emotions in the client, which influence the formation of an impression of it.

The interaction with the restaurant, which has a dining space, takes place at a much higher volume than in a dark kitchen. Dark kitchen has no influence on the atmosphere as such, as the customer only interacts with the delivery service or the delivery point, so one of the assumptions was that because of this, the willingness to pay would be higher in a regular restaurant than in a dark kitchen.

Firstly, has been run pre-test, after which we did the main study. In the main study, 102 participants took part. The formulated hypotheses did not confirm the existence of a difference between the two conditional groups of participants in the experiment. From the business perspective, it means that the type of restaurant - if it has dining space or not, is not essential to customers, and they are ready to pay no less for the food produced in a dark kitchen than in usual restaurants. However, after this study, we did not confirm that trust in the quality of products and services are different between restaurant and dark kitchen condition; this does not take away from the fact that the environment in which the food is produced is essential to customers. All of this suggests that the dark kitchen can compete with an ordinary restaurant in Portugal if certain conditions are met.

This study found insight about choice between a restaurant and a dark kitchen in the circumstances with time limitations. Was set a condition that if the restaurant with dining space is 40 minutes away and delivery from the dark kitchen takes 25 minutes, the customer will choose delivery. In such circumstances, the average mean in dark kitchen conditions was significantly higher than in restaurant condition: $M = 3.38$, $M = 2.59$, $F(1,56) = 6.56$, $p = 0.013$. This could lead to these results because people in the restaurant condition group did not become

familiar with the description of “dark kitchen”; that is why they prefer to go to the place they are familiar with, such as an ordinary restaurant. However, people were already familiar with the dark kitchen term in the dark kitchen group. According to the results, they were more loyal to this type of restaurant and ready to order food from it, despite the slight time difference between the two options and the presence of the familiar, ordinary restaurant. This result shows how important it is for restaurant owners not only to focus on the quality of the products that are used for cooking but to talk about it to the customers. It is essential, especially for dark kitchens, to make the cooking process transparent or convey to customers information about how product quality control is carried out. Since the concept of a dark kitchen is pretty new for Portuguese customers, they do not have enough interaction experience to ensure the quality of a dark kitchen restaurant.

The term “dark kitchen” is not well-known yet (Hakim et al., 2022), but by increasing the amount of information about dark kitchens, the level of trust and loyalty to the concept can be increased.

Another interesting fact about the importance of time, which has been found in this study, is that when was asked: “How much time are you willing to spend for delivery from a dark kitchen and for the road to the restaurant” the direction of the answers in two conditions was the opposite. In the dark kitchen condition group, for example, participants were willing to wait an average of 27.6 minutes for delivery, whereas they were willing to spend 24.3 minutes on the way to the restaurant. The restaurant condition group indicators were 24.4 minutes for delivery and 27 minutes, respectively. This may also be a result of respondents from the restaurant condition group not knowing the term and concept of dark kitchen.

All findings lead us to the conclusion that there are possibilities to develop dark kitchen restaurants in Portugal. To be effective, owners of dark kitchen restaurants must improve customers' knowledge about this type of restaurant. Another critical factor is the reviews which play a crucial part nowadays, and it is necessary to work with customers and improve their experience towards interaction with dark kitchen restaurants.

Answering the main research question – yes, a dark kitchen can compete with an ordinary restaurant in Portugal. However, it is necessary to consider some factors, one of which is time, and other factors yet to be identified in the following studies.

# 5. LIMITATIONS AND FUTURE RESEARCH

This study has some limitations. This is the first study about dark kitchens in Portugal, and many people are unfamiliar with this term. Second, this study gives just the overall picture of choosing between two conceptually different types of restaurants. This study does not consider the type of cuisine in the restaurant, whether it is a pizzeria, burger place, or one of the other types. Types of restaurants may affect the attitude and preferences between the usual one and one with the dark kitchen model. For example, a dark kitchen model could be a good solution for a pizzeria or burger place, but with the fine dining type of restaurants - it is probably, not the best solution. Another limitation is the lack of information about the order process - with or without using the delivery application and who is responsible for delivery. We did not divide whether the restaurant uses a delivery service operating by itself or using an external delivery service (e.g., Glovo, Uber Eats, Bolt food). The delivery process may be influenced by positive or negative user experience directly with the delivery brand (e.g., Glovo, Uber Eats, Bolt food). Next limitation that we did not take into account is if there is a pick-up point for customers, which can positively influence attitudes since it opens up a little information about dark kitchen restaurants. Furthermore, another limitation is the number of respondents for this study.

For future researches, it is recommended to take a larger sample of participants and divide it into segments to find more accurate correlations. Also, a geographic distribution could give some insights about customers' choices. For instance, comparing big cities like Lisbon and Porto with smaller ones, which do not have the variety of restaurants, is the same as in big cities. One more recommendation is to divide types of dark kitchen restaurants into two existing types: hubs and individual restaurants. It is also recommended to consider which delivery types are used - one of existing (e.g., Glovo, Uber Eats, Bolt food) or owned by a restaurant. Also, future researchers could find and specify types of food that could be acceptable for dark kitchen restaurants. For instance, fine-dining restaurants and pizzerias are entirely different.

Finally, to ensure the development of dark kitchens in Portugal, it is necessary to identify what gives moderation or mediation effects to understand what influences clients' choices and how to satisfy their needs.

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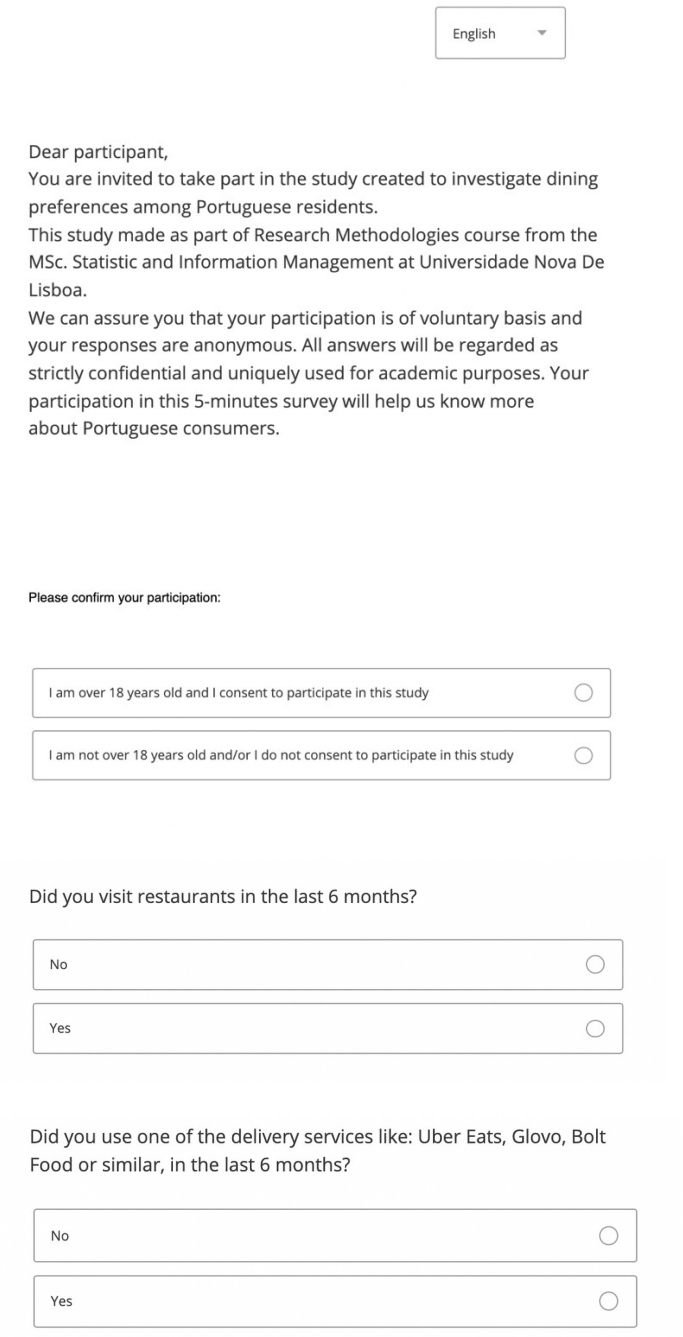
# ANNEXES

## SURVEY

*1 group of questions – defining sample:*



Do you live in Portugal for the past 6 months?

- No
- Yes

*2 group of questions – randomized block (restaurant and dark kitchen):*

This is usual restaurant nearby, where food is served to a table.


Please rate the following statements:

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I believe that cooking conditions in this restaurant are good | ○ | ○ | ○ | ○ | ○ |
| I believe that good quality of products are used for cooking in this restaurant | ○ | ○ | ○ | ○ | ○ |
| I believe in the professionalism of the team of this restaurant | ○ | ○ | ○ | ○ | ○ |
| I believe that sanitary standards are respected in this restaurant | ○ | ○ | ○ | ○ | ○ |
| I believe that if I have questions or doubts about food - team of this restaurant will help me | ○ | ○ | ○ | ○ | ○ |

This is burger from this nearby usual restaurant. You can order this burger and it will be served to you in the restaurant.

How much you would pay for it?

Price of the burger in €

0 20 40 60 80 100

0 €

*3 group of questions:*

Tell us what do you think about statements below.

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| Visiting a restaurant is social activity which is important for me | ○ | ○ | ○ | ○ | ○ |
| If I don't have enough time to go to restaurant I will chose delivery from dark kitchen | ○ | ○ | ○ | ○ | ○ |
| I believe that food in dark kitchen should be cheaper than in restaurant | ○ | ○ | ○ | ○ | ○ |
| I believe that the dark kitchen concept has opportunities to beat the restaurants | ○ | ○ | ○ | ○ | ○ |
| Even if I do not have free time, I would prefer a visit to a restaurant | ○ | ○ | ○ | ○ | ○ |

How much time are you willing to spend on the road to the restaurant?

Time on the road to the restaurant (in minutes)

0 20 40 60 80 100 120

0 min

How much time are you willing to spend waiting the delivery from the "Dark kitchen"?

Time waiting for delivery (in minutes)

0 20 40 60 80 100 120

0 min

Imagine that the closest restaurant with dining space is 40-min away. Delivery from the "Dark kitchen" takes 25 minutes.

| | Strongly disagree | Somewhat disagree | Neither agree nor disagree | Somewhat agree | Strongly agree |
|---|---|---|---|---|---|
| I would rather chose delivery | ○ | ○ | ○ | ○ | ○ |
| I would rather go to the restaurant | ○ | ○ | ○ | ○ | ○ |

*4 group of questions – demographic:*

What is your gender?

- Male
- Female
- Prefer not to say

What is your age?

What is your education level?

- Básico
- Secundário
- Pós-secundário não superior
- Superior
- Licenciatura
- Mestrado
- Doutoramento

What is your average monthly income?

- 800€ or less
- 801€ - 1500€
- 1501€-2500€
- more than 2500€

What is your family status?

- Married
- Single
- Divorced
- Separated
- Widowed

How many children do you have?

- I don't have children
- 1
- 2
- 3
- 4 and more