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Eating healthy and sustainable: consumer awareness, perceptions and attitude towards mushroom consumption in Kigali, Rwanda

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While the health and sustainability aspects of diets in high-income countries have received great attention, the dearth of research on food-related health and sustainability aspects in low-income countries needs to be addressed. Focusing on mushroom consumption as an example of a healthy and sustainable dietary practice, this study examines consumers' awareness and knowledge towards healthy and sustainable eating and explores the attitudes and barriers towards mushroom consumption in Kigali, Rwanda. Data from 16 in-depth interviews and two focus group discussions were thematically analyzed using MaxQDA 24.3.0 through the lens of the Theory of Planned Behavior and the New Ecological Paradigm Scale. The results indicate that awareness on food related sustainability issues is limited, and most respondents reported being indifferent to environmental concerns in their food decision making process. While healthy diets are perceived as those containing plenty of vegetables and fruits, unhealthy diets are described as those containing high amounts of sugar, salt and fats, including overconsumption of meat products. The results also highlight mixed attitudes toward mushroom consumption, shaped by cultural misconceptions, limited availability, and gaps in cooking knowledge. The findings underscore the need for interventions to enhance awareness on healthy diets and sustainability, while mushroom consumption could be supported by developing the value chain to ensure all-season availability, accessibility and affordability.

KEYWORDS

mushrooms, Rwanda, sustainable consumption, eating healthy, TPB, new ecological paradigm scale

1 Introduction

Despite the United Nations' Sustainable Development Goal of ensuring sustainable production and consumption patterns, the current global food production and consumption patterns are unsustainable, depleting the planet's resources while, at the same time, exposing human populations to increased incidences of morbidity and mortality from diet related

diseases (Hemler and Hu, 2019). In the Global South, rapidly developing countries like India and Brazil experience an emerging upper class with consumption levels comparable to those in middle or upper classes in the Global North (Bhar et al., 2022).

For Sub-Saharan Africa, projections indicate that the growth in meat consumption could lead to an increase in greenhouse gas emissions by 1.4 (0.9–1.9) Gt CO₂e/year (Falchetta et al., 2021). Meanwhile, undernutrition, anaemia and obesity remain prevalent (Christian and Dake, 2022). In South Africa for example, obesity in the general population is predicted at 47.7% among females and 23.3% among males by the year 2025 (van Vollenstee and van der Merwe, 2021). In Kenya and Ghana, previous research established that nearly 30% of the general population consumed unhealthy diets (Rousham et al., 2020).

In Rwanda, while policies have been largely dedicated to enhancing food production to address food insecurity and stimulate economic growth, less attention was paid to the scourge of rising non communicable diseases (NCDs) due to unhealthy diets (Ruhara et al., 2021; Ulimwengu et al., 2024). As of 2020, NCDs contributed to 36% of hospital deaths (MOH and World Health Organization, 2020) and 50% of deaths annually (MOH, 2024; MOH and World Health Organization, 2020). Between 2010 and 2017, an increase of 167.5% of diabetes cases was observed among the 29–70 year-olds, while the national cancer registry reported a substantial increment in cancer prevalence, rising from 634 cases in 2007 to nearly 3,000 cases in 2018 (MOH and World Health Organization, 2020). At the same time, obesity and overweight in women of reproductive age have become a public health concern, especially in urban areas where 36.8% of women were overweight or obese by the year 2015. Paradoxically, undernourishment and child stunting have also remained high (Kalinda et al., 2024; Ngango et al., 2022; National Institute of Statistics of Rwanda, 2013).

As a result of rising incomes, coupled with an unprecedented rate and scale of globalization, the growing middle class in urban areas increasingly resorts to unhealthy diets, characterized by excessive consumption of meat, sugars and fats (Nsabimana et al., 2024; Ruhara et al., 2021). In light of this, the Government of Rwanda recently adopted the National NCDs management guidelines, which encourage the consumption of vegetables, fruits, whole grains, fat free or low fat dairy, fish, poultry, beans, nuts and seeds, and vegetable oils (MOH, 2024).

However, despite the foregoing, little to no attention has been paid to understanding consumers' perceptions and attitudes towards healthy and sustainable eating in Rwanda. While previous studies focused on healthy and sustainability aspects of diets in high-income countries (Alae-Carew et al., 2022; Chezan et al., 2022; Hoek et al., 2017; Mann et al., 2018; Nina Van Dyke and Michael Murphy, 2024), the dearth of research on consumers' knowledge, awareness, perceptions, and attitudes towards healthy and sustainable eating in the low-income countries needs to be addressed. Assessing the perceptions and knowledge of Rwanda's urban consumers on healthy and sustainable diets is critical to support the implementation of diet-related NCDs management guidelines, as highlighted above. To our knowledge, no study has been carried out to understand consumers' awareness on healthy and sustainable diets in Kigali city, apart from Habumugisha et al. (2024), who sought to understand older adults' perceptions about meat consumption in Gasabo District.

The current study seeks to address this research gap by exploring the perceptions of urban consumers on healthy and sustainable diets,

specifically focusing on mushroom consumption as an example of healthy and sustainable food option. Although the Government of Rwanda introduced mushroom cultivation in the country's agricultural system as one promising avenue to promote healthy and sustainable eating, mushroom consumption has, so far, been limited to a relatively tiny percentage of the population and mushroom-containing dishes remain generally uncommon in Rwanda, especially in urban areas. The fruit body of mushrooms is low in calories, fat, and cholesterol, while being rich in protein, carbohydrates, fiber, vitamins, and minerals, making mushrooms a highly beneficial food for a healthy diet (Claude et al., 2024). In addition to the reported nutrition and health benefits of regularly eating mushrooms (De Cianni et al., 2023; De Cianni et al., 2024; Poddar et al., 2013), mushrooms are climate resilient, resource efficient (Mutema et al., 2019), and their life cycle assessment reveals less carbon emissions as opposed to meat (Dorr et al., 2021). In other Sub-Saharan African countries like Ghana and Nigeria, previous research has demonstrated that mushroom consumption is widely accepted and could be determined by various factors like age, household size, education, availability, cooking ability, medicinal benefits and price (Elizabeth Adegbenjo et al., 2020; Iddrisu et al., 2014; Owusu and Anang, 2023).

Although mushrooms are known to be relatively affordable, nutritious and culturally acceptable in many African settings (Aa et al., 2024), there has been no empirical attempt to investigate the consumers' perceptions, attitudes and impediments to mushroom consumption as a potentially healthy and environmentally friendly food option in Rwanda. Understanding these aspects is yet paramount to developing actionable recommendations to improve consumer acceptance and adoption, which are critical to industry development.

The aim of this study is thus twofold: (1) explore Rwandan consumers' knowledge, awareness and attitude towards healthy and sustainable eating practices and (2) examine the perceptions, attitudes and perceived barriers to mushroom consumption as a healthy and sustainable food. Using an exploratory qualitative approach, we address the stated goals by conducting focus group discussions and individual consumer interviews in Kigali city. The rest of the paper is organized as follows: section two explains the theoretical framework employed to set up both the interview and focus group questions; section three describes the research design and methodology in detail, section four highlights the results and discussions while section five presents the general conclusions.

2 Theoretical and conceptual framework

Within a plethora of theoretical models to explain consumer behavior and promote sustainable eating practices, the Theory of Planned Behavior (TPB) model has received significant attention from social scientists, thanks to its flexibility and adaptability to different cultural contexts and backgrounds (Cousins et al., 2024; Wolstenholme et al., 2021), making it one of the most widely applied theories in social and behavioral sciences (Bosnjak et al., 2020). Indeed, the TPB model allows researchers to extend the model by incorporating other culturally appropriate variables to mediate the effect of predictors on the intention, for the TPB model assumes that the individual's intention to practice a certain behavior leads to behavior implementation. Intention is thus used as a proxy to predict the

behavior implementation, while the individual's attitude (i.e. behavioral beliefs and outcome evaluations), subjective norms (normative expectations of others) and perceived behavior control can be used as latent variables to predict the intention (Lehberger et al., 2021). In Figure 1, we provide a graphical depiction of the model as adapted from (Bosnjak et al., 2020). We maintain that the model constructs may also be influenced by general awareness, knowledge and cultural beliefs which, in turn, may have a bidirectional relationship as indicated.

Environmental awareness, which was assessed by items from the New Ecological Paradigm Scale (NEP), is also believed to form personal beliefs and attitudes towards sustainable eating and mushroom consumption, in particular. The NEP scale embodies the environmental attitudes of respondents (Lopez, 2016). In contrast with the Dominant Social Paradigm (DSP) in the 1970s, the NEP scale places emphasis on the harmonious relationship that ought to exist between humans and nature (Reyna et al., 2018). It thus questions the anthropocentric, exploitative relationship that was premised on the understanding that nature was to be solely utilized as tool to meet people's needs and cautions against the depletion of resources and earth's carrying capacity. However, since our study is qualitative, the selected NEP scale items were collectively discussed during focus groups, and the respondents' level of environmental awareness was gauged by their approval or disapproval of the selected items from the NEP scale. The methodological details, i.e., how we empirically operationalized the TPB framework in combination with the NEP scale are presented in section 3.

3 Methodology

3.1 Study area

This study has been conducted in Kigali city, the capital of Rwanda. It is the main political and economic city, serving as the primary destination for tourists, visitors and investors. In addition to being a home to nearly two million people (Habumugisha et al., 2024),

Kigali has recently become an international destination due to numerous cultural and natural attractions. Moreover, the country maintains an open border policy to all citizens of the world and entertains multiple refugee and asylum seeker hosting agreements which, in combination with the colossal investments made in ICT and infrastructure, make it one of the most rapidly globalizing cities on the continent. Due to rapid urbanization, economic growth and globalization, Kigali residents increasingly opt for energy-dense and nutrient poor diets, incorporating more animal foods and processed foods and fats in lieu of the traditional mainly plant-based diets as recently reported in (Nsabimana et al., 2024).

3.2 Study design

In the absence of consumer studies on awareness and consumption of healthy and sustainable foods like mushrooms, we conducted an exploratory, qualitative study to examine the perceptions, awareness, and attitudes toward healthy and sustainable eating, focusing on mushroom consumption, in particular. Our focus was on specialty cultivated mushrooms, recently introduced into Rwanda's agricultural system as one avenue to combat malnutrition, child stunting and food insecurity. Specialty cultivated mushrooms were selected in this case because, due to deforestation and continuous encroachment on marginal lands, wild mushrooms are increasingly rare and hard to find in Kigali city. A qualitative approach was preferred since the main goal was to investigate participants' worldviews and experiences on the situation being studied, and to elaborate on the social cultural dimensions of healthy and sustainable eating practices which could not be fully understood with quantitative measurements that presuppose an already existing, pre-defined set of variables and factors that could hypothetically be in a causal relationship with the phenomena being studied (Creswell and David Creswell, 2018; Sgroi et al., 2024). Qualitative methods challenge a top-down approach in research, allowing participants to freely express their own views and opinions without being constrained by strict researcher-determined sets of choices and alternatives. They have been previously proven

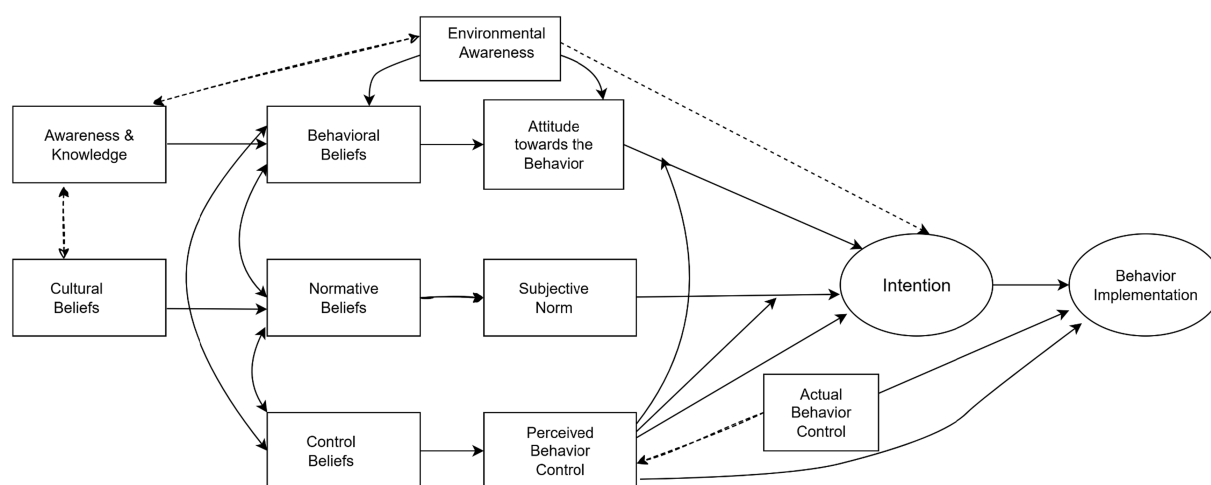


FIGURE 1
TPB framework adapted from (Bosnjak et al., 2020).

effective and appropriate to elicit Rwandan consumers' perceptions about food (Albin et al., 2024; Habumugisha et al., 2024). For the purposes of this study, two focus group discussions (FGDs) and 16 individual, semi-structured, in-depth interviews (IDIs) were held in Kigali city.

3.3 Study participants' selection

Through convenience sampling, data were collected from May to June 2023. Attention was paid to recruiting various strata of the population in Kigali, ensuring that various views on the subject are accounted for. Variation in the sample units allows for multiple perspectives and experiences related to the subject (Guest et al., 2017; Habumugisha et al., 2024). In this study, important variations considered were age group, educational level and religion. In total, 32 participants were recruited: the 16 individual interview participants were recruited at the exit/entrance of Kimironko market, one of the busiest vegetable markets in Kigali.

With regards to IDIs, convenience sampling was selected for its ability to also include the perceptions and beliefs of non-mushroom consuming participants. To increase chances of participation as recommended in (Stratton, 2021), participants were recruited on two separate days namely Friday and Saturday to provide those that would usually be at work from Monday to Friday with a possibility to participate. Over the two days from 7 am to 6 pm, 24 people were approached at the market's entrance/exit (can be used interchangeably because there are no separate gates). The investigator and the research assistant first introduced themselves, explained the subject and purpose of the research and asked them whether they would be willing to participate. Eight potential participants declined the request. After signing the declaration of informed consent, each participant was ushered to a quiet place in the vicinity to conduct the interview. Participants' recruitment ended at the 16th interview, when theoretical saturation was assumed.

The first focus group was made up of university students in the department of natural resources management at a local university. The participants in the second focus group discussion were recruited from a village (the lowest administrative entity in Rwanda) in Kicukiro District. This approach stimulated the conditions for various worldviews to emerge, given that the university students were younger and more educated compared to the second FG participants. Each focus group had eight participants to allow for optimal circumstances to conduct meaningful discussions as recommended in (Guest et al., 2017), who also suggested that two to three FGDs might be sufficient to discover more than 80% of the most prevalent themes in the dataset.

The respondents were approached by the principal investigator, who explained the intent of the research, the modalities and the duration of the proposed interviews and discussions. Participants were selected on the condition that they lived in Kigali city, were at least 18 years of age, and were fluent in Kinyarwanda, the local language in which interviews and focus group discussions were held. Interviews took place after the respondents had understood the conditions for participation and freely agreed to sign an informed consent form. It was clearly indicated that the study aimed to find out how they perceived mushroom consumption and healthy eating in general, and that no repercussions would ensue had they decided not to participate. The research protocol was approved by the National

Institute of Statistics of Rwanda (0053/2024/10/NISR) and the Protestant University of Rwanda' Ethics Review Board.

3.4 Data collection

Prior to data collection, two separate interview guides were set for both FGDs and IDIs. The original interview guides were written in English, comprising questions set to reflect the constructs in the extended TPB and selected items of the NEP scale as discussed in section 2 above. The FGDs sessions were subdivided into two parts: the first part focused on the views and perceptions about healthy and sustainable eating practices by asking questions like, *how does a typical Rwandan dish look like? How do you decide on what food to cook and eat daily?* Here, responses related to health were built on to transition from general eating behavior to healthy eating with questions such as, *what do you think people should eat to stay healthy? Or is it common that you all select your food items with your health and that of your loved ones in mind?*

It was not so obvious that the respondents associated food with sustainability challenges. Therefore, the researcher made the transition from food preferences and health to food and environmental sustainability by asking them whether environmental sustainability was also taken into consideration while deciding on the food to eat, which immediately led to the NEP scale. However, although the NEP scale normally comprises 15 items (Anderson, 2012), we selected only seven items for simplicity and time management. The selected items were deemed clearer and easier to grasp by the participants, with three representing the Dominant Paradigm Scale and four representing the New Environmental Paradigm (Anderson, 2012). It is worth highlighting that our purpose was neither to calculate the NEP scale, nor to make any statistical inferences on the participants' environmental attitudes based on the scale. The NEP items were introduced to have a qualitative appreciation on whether the respondents were environmentally concerned. The researcher read out each item, and the respondents indicated the level of agreement or disagreement by using thumbs in different postures and motions. An upward-facing, flashing thumb indicated an extremely high level of agreement while a downward-facing, flashing thumb expressed an extreme level of disagreement. The first FG, comprising young university students, seemed better equipped to understand and interpret the NEP scale statements, while participants in the second FG discussion appeared struggling to understand what the statements meant, despite having been carefully and properly translated in Kinyarwanda. The primary investigator had to intervene and clarify what the questions meant, suggesting that these questions were not fully adequate for the target audience. The complexity of NEP scale items was already observed during our pre-test interviews, which led to their dismissal in the individual interviews, after coming to the realization that respondents were unable to understand them and formulate an independent opinion.

To evaluate the respondents' awareness and attitudes towards sustainable diets, they were subdivided into small groups to discuss and report on both sustainable and unsustainable foods that people eat. They wrote their answers on flip charts and a group

representative had the opportunity to explain the answers in the plenary session. For a smooth transition to perceptions and attitudes towards mushroom consumption using the TPB model, the researcher presented freshly harvested oyster mushrooms to the participants and subsequently asked them to explain what they think or have heard about mushrooms. To assess the normative beliefs and social norms, we asked questions about how family, friends, colleagues at work and relatives perceived mushroom consumption. We also asked them to explain whether they had eaten them at banquets or weddings, or whether they had served their guests with mushrooms. If any participants had served guests with mushrooms, we followed up with a question like: *What did your guests say about your cooked mushrooms? Did they like to eat it?* Etc. Perceived behavior control questions related to the price of mushrooms, all season market availability, distance to the nearest market or the ability to cook mushrooms. Table 1 shows the questions administered in both IDI and FGDs in relation to the conceptual framework.

To explore the perceptions and/or beliefs about mushrooms, FG participants were asked in smaller groups to write the reasons for which they thought people would or would not want to eat mushrooms. Further, participants were assigned in pairs and asked to play the mushroom vendor-buyer roles. Here, each group received mushrooms, and they were asked to act as if one was selling, thus having to market the product by explaining all the good things they knew and thought about the mushrooms, and the other was acting as a buyer. The buyer was asked to find some arguments to convince the seller to reduce the price. This play method proved useful to dig out information that was not previously captured in the open-ended questions. The FGDs lasted 83 min and 88 min, respectively. The discussions were recorded with a voice recorder to supplement the researcher's notes. IDIs were also conducted in the same order of sequences, except for the questions that were answered in pairs or groups of three during the FGDs. IDIs lasted about 30 min on average, and they were also audio-recorded.

3.5 Data analysis

Recorded data were transcribed verbatim then translated to English for analytical purposes. In addition to the first authors' translated version, an independent translator was hired to carry out the translations, and a final set of translated documents was adopted after cross comparisons and verifications for language accuracy. Respondents' direct identifiers such as names in the file names were replaced by numbers, from one to 16, while participants' names were traced and removed throughout the coded text. MaxQDA version 24.3.0 was then used to conduct thematic analysis following a mixed inductive-deductive approach as in (Schüßler et al., 2024). Following a first screening through the data, a list of deductive codes was established by the researcher, while thorough reading of the data files, line by line, permitted to generate inductive codes to classify textual data into smaller units that could be meaningful to the objectives of this study (Specht et al., 2016). Following the steps on how to conduct thematic analysis as described in (Vaismoradi et al., 2013), generated codes

were then collated into potential themes and sub-themes as in Figure 2 below:

4 Results

Among the 32 study participants, 17 were male, and 15 were females. Half of respondents were 30 years old or younger, eight were aged between 30 and 40, while the remaining eight respondents' age was higher than 40. Most participants had achieved secondary school education or higher, while seven had not made it to high school as shown in Table 2 below.

4.1 Respondents' dietary regime

Most respondents described themselves as meat eaters or flexitarians (in this study 'flexitarians' refers to respondents who primarily follow a plant-based diet but occasionally consume animal products). It should be noted that, for most of them, the dietary regime was not a result of a thought process. They maintained that they did not choose to be flexitarians because they were 'born that way' as in the following:

'That's how I found it in my family since I was born, and I continued like that even after I grew up' (Interview 13, Pos. 17).

Vegetarians, however, opted for a plant-based diet due to moral reasons, while vegans stated that they wanted to protect their health as in the following interview passages:

'It started last year. I was going to eat meat, prepared at my workplace, and then I saw blood. I felt bad about it and immediately developed anti-meat feelings' (Interview 3, Pos. 16).

'I am a vegetarian. I became a vegetarian since 2018. I read about animal welfare, and I believe that I can contribute to a noble cause in my own small way' (Interview 9, Pos. 13).

'I wanted to protect my health, protect myself against any diseases that might be inherent to the consumption of animal related foods. So, the consumption of animal foods such as milk, meat, eggs bears risks because these animals might carry some pathogens that might move from animal to person. What's more, these animal products also have amounts of cholesterol and fats that are likely to cause this into humans and so it's not necessary because all the necessary nutrients can also be found in plants' (Interview 5, Pos. 18) (see Figure 3).

4.2 Perceptions of 'healthy' versus 'unhealthy' foods

During both IDIs and FGDs, participants discussed what they perceived as healthy or unhealthy foods that they generally eat. Quasi-unanimously, respondents suggested that healthy foods are those made up of plenty of vegetables and fruits. They also hinted that

TABLE 1 Example of IDI and FGD questions used for the operationalization of the conceptual framework.

Exploring awareness, beliefs and attitudes towards healthy and sustainable eating	Exploring environmental awareness with the NEP scale	Awareness about mushroom consumption	Perceptions and beliefs about mushroom consumption	Personal attitude towards mushroom consumption	Subjective norms about mushroom consumption	Perceived behavior control
What do you think people should eat to stay healthy?	Our behavior in terms of food choice, preparation and consumption impacts our planet	Who can tell us what they know about mushrooms? This can be anything from taste, color, benefits, or anything	What do people say about eating mushrooms in your area?	What do you think about eating mushrooms?	Is it common to see mushrooms served on special occasions like weddings, birthdays or other parties in Rwanda?	Could you tell any factors or circumstances that would make it easier or enable you to regularly consume mushrooms in your diet?
Is it common that you select your food items with your health and that of your loved ones in mind?	We are approaching the limit of the number of people that the earth can support	Do you often see mushrooms served in restaurants?	What do you think are reasons why people you are familiar with do not or would not eat mushrooms?	Will you keep eating mushrooms even in the future?	What do your friends, colleagues or relatives think about eating mushrooms?	What factors or circumstances could make it difficult or prevent you from regularly eating mushrooms in your diet?
Do you also consider sustainability when deciding on the food to eat?	We, humans, have the right to modify the natural environment to suit our needs	Who among you, has eaten mushrooms this week? Who ate them last week? Last month?	What do you think are the reasons why people you are familiar with do eat or would eat mushrooms?	Would you recommend other people to eat mushrooms as well?	Do you know whether your neighbors eat mushrooms regularly? What do they say about eating mushrooms?	Would you say that you are a good mushroom cook? What are your preferred ingredients/recipe for a good mushroom meal?
Could you give examples of healthy foods that you regularly eat? Which foods do people eat that can be deemed unhealthy?	Humans are extremely degrading the earth and the environment	In your opinion, do you think there could be any nutritional benefits of eating mushrooms?	Where do you regularly purchase mushrooms?	If you do not eat mushrooms, what would you say or do if a friend you visited served you mushrooms at the table?	Do you also like serving mushrooms to your guests at home? If not, why? If, yes, what do they say?	If no, who cooks them for you? Is that person always available and willing whenever you want to have a mushroom-composed meal?
Which are the environmentally sustainable foods that you regularly eat in your diet?	The earth is like a spaceship with limited space and resources	In your opinion, do you think there could be any environmental/ecological benefits of eating mushrooms?	Are those points of purchase convenient for you?		Do you know whether your parents or grandparents also eat or used to eat mushrooms?	Do you always find mushrooms available at the market whenever you need them?
What foods do you think are environmentally not sustainable?	Human ingenuity will ensure that we do not make the earth unlivable		In your view, what do you think could be the disadvantages of eating mushrooms?		If yes, when did they eat them? Where did they get them? How were they used to cooking them?	
Which foods can be regarded as both healthy and environmentally sustainable?	Humans were meant to rule over the rest of nature					

health authorities should encourage more fruit consumption because it was not culturally considered appropriate for adults in Rwandan households to eat fruits in their ordinary life as in the following excerpt:

‘.....and if possible as the government is encouraging people to have at least one fruit tree in their garden so that each meal would have at least one fruit. So, it is important to emphasize on the role of fruits because in the Rwandan culture eating fruits was not a priority for grown-ups, especially men!’ (Interview 7, Pos. 27).

While many participants in the IDIs avoided providing examples of healthy foods by branding the concept of a balanced diet (one which contains enough proteins, carbohydrates and vitamins), participants in FGDs mentioned vegetables such as amaranths, beans, carrots, along with other foods like eggs, anchovies (small, dried fish), rice, potatoes, cassava, and fruits like avocado, banana, mango and oranges as commonly eaten healthy foods.

On the other hand, unhealthy foods were regarded as those containing much salt, sugars, fats, as well as processed foods such as mayonnaise. Excessive consumption of red meat was also as reported unhealthy as in the following excerpts:

‘.... Too much red meat (more than three times a week), I know my brother who fell sick because of too much meat. Now he has developed inflammation in the fingers and joints, his legs cannot move sometimes’ (FGD2).

Out of eight participants per FGD, five maintain that eating meat more than three times a week is likely to negatively impact human health.

4.3 Participants’ ecological awareness through the NEP scale

We note that respondents in both groups agreed that human activities are extremely degrading the environment, and that one of the ways through which our environment and planet are degraded pertains to food preparation and consumption patterns. They also generally agreed that we are approaching the earth’s carrying capacity but mostly remain in the dominant social paradigm, with the belief that humans were meant to rule over the rest of nature. All participants in the second FG seemed to believe that human ingenuity will preserve the livability of the earth, while participants seem rather pessimistic or undecided in the first FGD. It is interesting to note the observable differences between two FGDs on the right of humans to modify the natural environment to suit their needs. In the first FGD, composed of young university students, none agreed with the statement, while half of respondents in the second FGD, composed of relatively older people with lower levels of formal schooling, either agreed or strongly disagreed.

4.4 Consumers’ understanding of ‘sustainable’ versus ‘unsustainable’ foods

In their small groups during FGDs, participants elaborated on both sustainable and unsustainable foods they eat. Their evaluation of

sustainability was mainly centered on processing, packaging and waste. Hence, packaged foods such as industrial, processed foods and drinks in plastic containers were pointed out as unsustainable as in the following excerpts:

‘...industrial food like spaghetti, salt, bottled water and packaged milk. In short, everything that we buy packaged in plastic bags and bottles!’ (FGD2, Pos. 89–90),

‘... We discussed and agreed on industrial foods that may come with increased acidity, and the way they are processed and packaged. Here, we look at the waste handling and disposal, which might negatively impact the environment. Industrial foods like spaghetti are packaged in plastic bags, which in turn get thrown in the environment’ (FGD1, Pos. 91)

In contrast, traditionally known and eaten foods are generally regarded as sustainable. Those include sorghum, peas, cassava, beans, potatoes, as well as vegetables and fruits.

4.5 The role of environmental sustainability in consumers’ food choices: does it matter?

To understand whether environmental sustainability has a role to play in consumers’ food decision making processes in Kigali, we explored the factors participants consider when selecting the type of foods to eat. It appears that not even one respondent mentioned environmental concerns in both FGDs and IDIs. The respondents stated, on multiple occasions, that they were not aware of the relationship between environmental sustainability and their daily choices regarding food items to consume:

‘We never thought about it,’ (FGD2, Pos. 50)

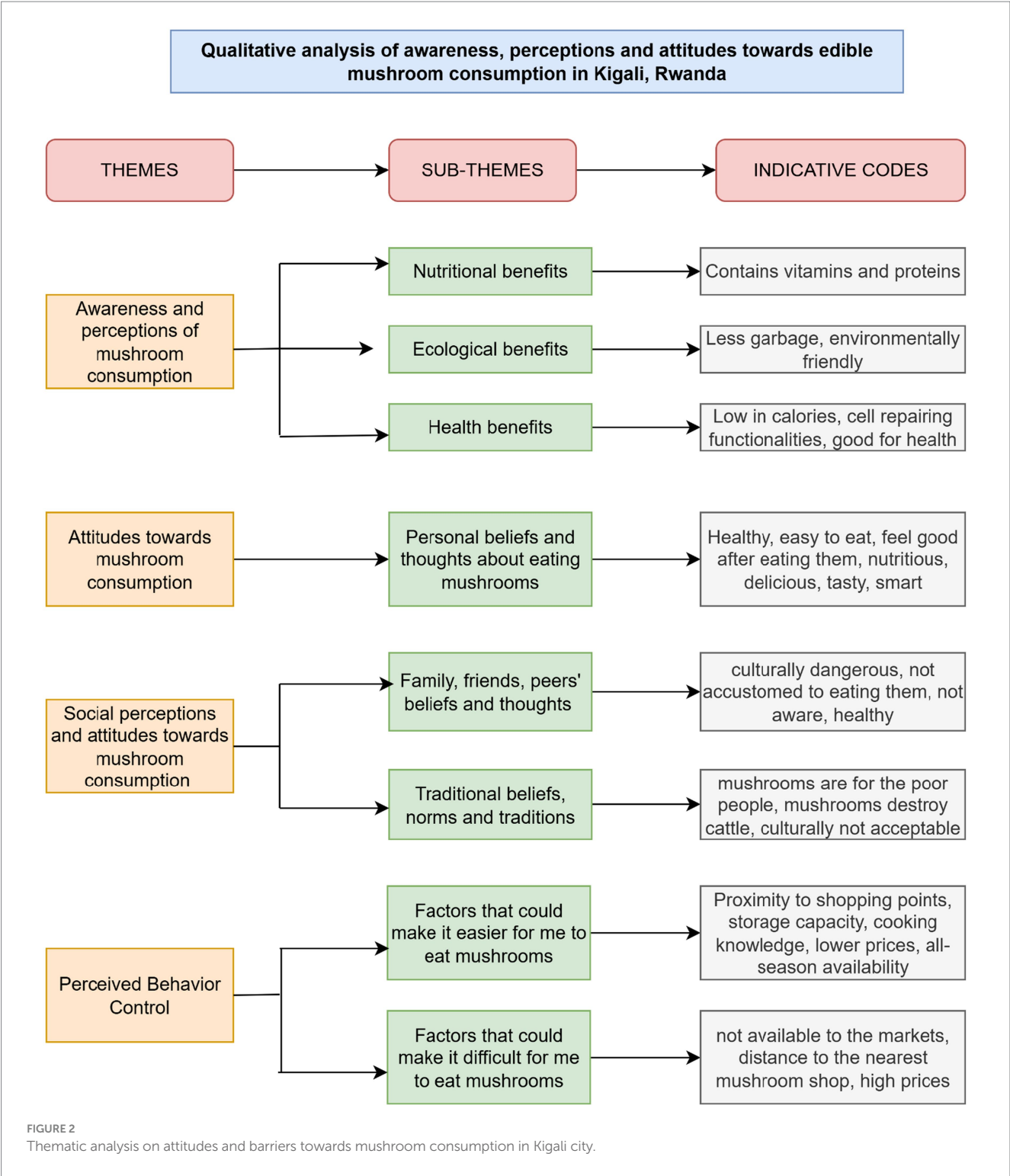
‘No, we really do not care about it’. (FGD2, Pos. 46)

The most recurrent criteria when it comes to putting food on the table pertains to affordability, which has received a lot of attention from our study participants with five coded segments in FGDs and two coded segments in IDIs. As shown in Figure 4, the following factors are considered while making food decisions in households whose members were interviewed:

In addition to affordability, food rotation, herewith conceptualized as the ability to diversify foods in a way that one does not repeat what they ate on previous meals, captures attention. It is common practice in Rwanda to do every best to ensure dinners look and taste differently from lunches, or at least in part.

4.6 Mushroom consumption frequency, location and preferences

As noted in the following excerpts, most respondents indicated that they had eaten mushrooms at restaurants and/or hotels, with some stating that they could not cook mushrooms at their respective



homes due to lack of knowledge of how to prepare delicious mushrooms at home or due to unavailability:

because they used to harvest them. It is even difficult to see them at the shop anywhere here' (Interview 3, Pos. 33).

'...I can only eat them either in a restaurant or hotel when I want them and/or have the money' (Interview 14, Pos. 63).

'...I eat them in a hotel or restaurant. I have never seen them at home. We grew up seeing villagers from rural areas eating them

With only five respondents having reported having eaten mushrooms at home, it can be inferred that consumption levels remain low. Those who stated eating mushrooms had eaten them either rarely, once a month, twice a month or once a week as reported during the interviews and FGDs.

TABLE 2 Demographics of the respondents

Gender	Male	17
	Female	15
Age	≤ 29	15
	30-40	8
	41-50	4
	51-60	2
	61-70	2
	71-80	1
Education	Lower than High School	8
	High School diploma	5
	Advanced diploma	8
	Bachelor's degree	7
	Master's	2
	PhDs	2
Religion	Catholics	12
	Protestants	16
	7 th Day Adventists	3
	Muslims	1
Total		32

Respondents that cook mushrooms at home prefer to have them as sauce for the main meal, often fried together with other ingredients such as onions, garlic, and tomatoes as in the following excerpts:

‘.... I fry them (mushrooms), I put carrots, pepper, tomatoes, and I make a good sauce’ (Interview 12, Pos. 57).

‘...I like them cooked in a sauce and eat them with ugali, or with plantain and feed the baby...’ (Interview 3, Pos. 33).

4.7 Exploring the barriers to mushroom consumption based on the TPB framework

4.7.1 Knowledge, awareness and attitude towards mushroom consumption

The analysis of FGDs and IDIs revealed a spectrum of attitudes toward mushroom consumption among participants. It is important to underscore that respondents uttered mixed feelings and different levels of understanding when it comes to regularly eating mushrooms in their diet. On the one hand, there are extreme cases where respondents were either lacking knowledge or simply disliked their taste as evidenced in the statements below:

‘... We do not know mushrooms! Personally, I would think that they are regarded as vegetables. The little that I know is that they are cultivated indoors, so they cannot degrade the environment’ (FGD2, Pos. 97).

‘...they look disgusting! even when I see them, personally I immediately lose all my appetite! I ate them once, and they tasted awful so I never tried again’ (FGD1, Pos. 155–156).

On the other hand, there are respondents that appreciate mushrooms and manifest a positive attitude towards mushrooms. Respondents appreciate their taste and acknowledge their positive impact on human health. This can be evidenced in sample statements like:

‘....they are not likely to cause NCDs like diabetes. No known negative consequences on health, regardless of the quantity eaten’ (FGD2, Pos. 138).

‘...they are easy to cook, nutritious and contain vitamins...’ (FGD2, Pos. 98) ‘...mushrooms are nice. They contain essential nutrients, and I think we should be getting them more often’ (Interview 6, Pos. 44).

It is also important to note that respondents hold the view that mushrooms could be a good replacement for meat as reported in the statements below, although this could inhibit the generalized adoption of mushroom consumption, by entertaining the understanding that only people with dietary restrictions or those with meat allergies should be eating mushrooms. Meat is still widely appreciated for its taste and texture, making it relatively appreciated and regarded with high esteem as opposed to other types of foods.

‘..... They taste like meat. If one has no meat, they can enjoy the mushrooms. They can be consumed by those not eating meat’ (FGD2, Pos. 101).

‘.... What I know is that they can be a good replacement for meat (FGD2, Pos. 116).’

Some respondents also acknowledge that mushroom consumption may have several ecological benefits such as reduced agricultural carbon emissions, preservation of water resources and nutrient cycling as evidenced in the following statement:

‘... Yes, eating mushrooms can have environmental benefits. They are often grown using sustainable methods and require less water than many other plants. Mushrooms also contribute to soil health by improving nutrient cycling’ (Interview 2, Position 69).

When asked about the likely disadvantages of eating mushrooms, most respondents suggested that there are none but cautioned that poor handling of produces and inadequate cooking methods may lead to health-related complications.

4.7.2 Subjective norms: social perceptions of mushroom consumption

The adoption of mushroom consumption not only depends on personal perceptions, beliefs and attitudes. It also depends on the beliefs and perceptions of significant others such as family members, peers, work colleagues and friends. There too, a dichotomy of perceptions has been observed. For some participants, friends, neighbors and colleagues are supportive and believe that eating mushrooms is good and beneficial to human health, while, for others, friends and families remain totally unaware of the palatable nature of cultivated mushrooms and are

Dietary regime justification

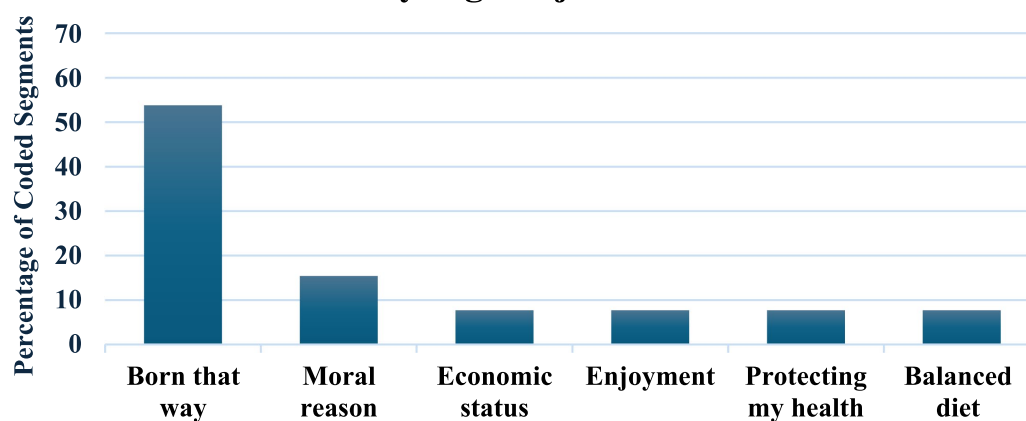


FIGURE 3
Respondents' dietary regime justification ($n = 32$).

Factors influencing Participants' Food Choice decisions

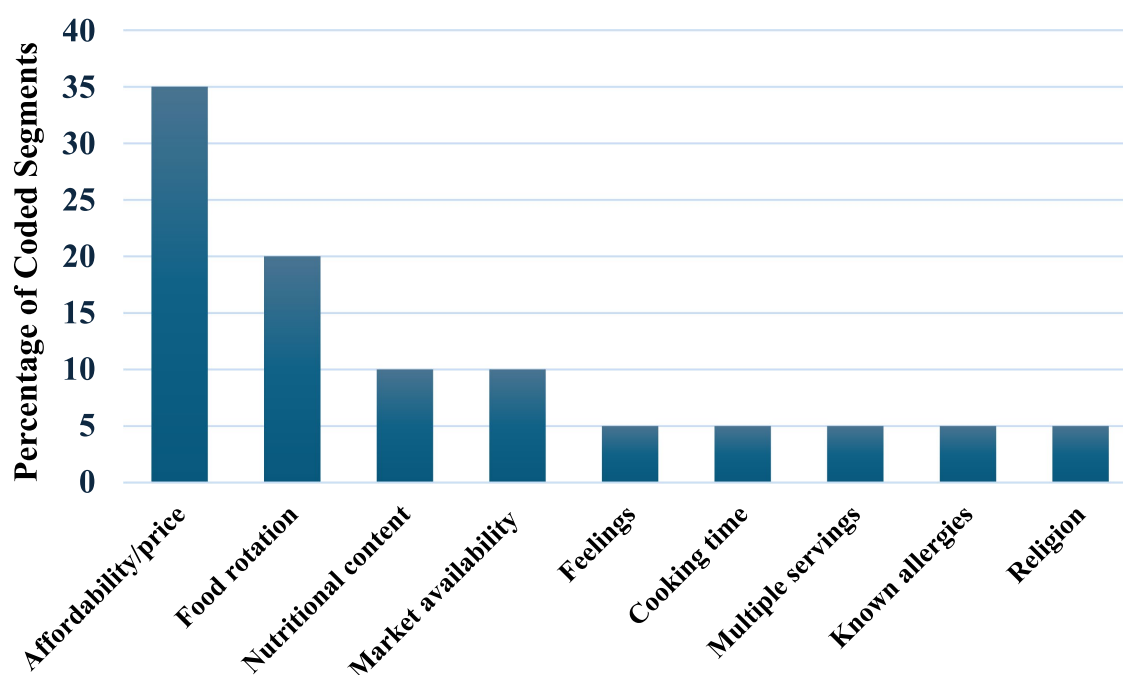


FIGURE 4
Interview results on the factors considered when deciding on what food to eat ($n = 32$).

constantly held back by some popular beliefs such as in the following excerpts:

'...they are delicious for the very few who happened to know them. But for most people, they have no information about them. They still believe they are to be eaten by poor people in rural areas' (Interview 3, Pos. 39).

'...So I have come to buy them to taste. But I was told that it is good for children and sick people' (FGD2, Pos. 146).

Here, the impact of traditional beliefs and cultural constructions cannot be underestimated. On many occasions, participants pointed to the role of social misconceptions against mushroom consumption that emanate from the Rwandan culture that is centered on cattle. Hence for some, eating mushrooms would be culturally dangerous as in the following interview passage:

'...they were superstitiously regarded as potentially dangerous to kill cattle and spoil the milk or prevent the cows' ability to produce as

much milk as it ought to. It was a social misconception because people were used to beans and sweet potato as the most common food' (Interview 6, Pos. 46).

4.7.3 Perceived behavior control: enabling versus inhibiting factors

In relation to the factors enabling study participants to consume mushrooms in their diet, participants largely pointed at the price, arguing that a cheaper price would facilitate their consumption of edible mushrooms. In addition, it is important to highlight cooking knowledge as the second largest enabling factor (Figure 5). Several participants expressed the need to acquire mushroom cooking knowledge since they are considered new in the urban settings in which the study was conducted. Participants also stated that all-time mushroom availability to the market would make it easier for them to eat mushrooms.

'...I think if they were cheaper, we would eat more often. A kilo is now about 3,500 FRW it is expensive but it's not too much like meat, which is now 4,500 FRW' (Interview 12, Pos. 46).

'...If I knew how they cook them, and how they grow them! It would be helpful if we learned how to cook and to grow them like we learned about the kitchen garden' (Interview 9, Pos. 45).

When looking at what makes eating mushrooms difficult for participants, however, the importance of price diminishes as it ranks third among the three factors identified namely 'unavailability, proximity to nearest points of purchase, as well as price. Respondents noted that they were unable to find mushrooms at the market whenever they needed them, adding that distribution and retail places were far from where they live, necessitating extra resources as some respondents suggested:

'...I love mushrooms but it is very rare to find fresh mushrooms out there even yesterday night I gave my husband a soup.... but I do not eat them quite often because of two reasons, first of all it's very rare to find them at the markets and even where they are, it is very far away from where I live. For me it's difficult to get mushrooms from kimironko Market' (Interview 7, Pos. 31).

'... there's a bit of a distance. It's not something you would think of suddenly and go to grab in the nearby shops and boutiques. I have to plan ahead; they are often found in bigger markets (Interview 8, Pos. 61).

'...they are not ubiquitous. If we could see them at every boutique and shops like we see amaranths, we would buy them more often' (FGD2, Pos. 134).

The availability challenges might be inherently due to the absence of a functioning value chain. Retail and distribution are often assumed by micro-scale entrepreneurs, who sell them per unit at a stand along with other vegetables at the market as shown in Figure 6.

5 Discussion

In this study, participants mostly identified themselves as flexitarians, confirming that consumers in Rwanda are of no exception to the findings of Hicks et al. (2018) who posited that flexitarianism was the default lifestyle for most of countries in the Global South. Indeed, although some participants highlighted that the frequency and amount of meat consumed have increased due to improvements in their living conditions as previously reported in (Habumugisha et al., 2024), flexitarianism is likely to remain the dominant dietary style for Rwandan consumers in the decades to come. This is because the detrimental health effects of excessive meat consumption are increasingly noticed. As noted in the Results section, some participants associated frequent red meat consumption with inflammation and other health risks, reflecting increasing awareness of diet-related illness. These results might suggest an improvement over the last decade when similar studies were reporting little to no knowledge of NCDs and risk factors among consumers in Sub-Saharan Africa (Aminde et al., 2017; Boateng et al., 2017). It has become clear in this study that health, along with nutritional importance, has an important role to play in determining what people eat. Apart from price that occupies the first position, herein examined under the token of affordability, health and nutrition were the major factors influencing participants' food choices (Figure 4). Although participants were

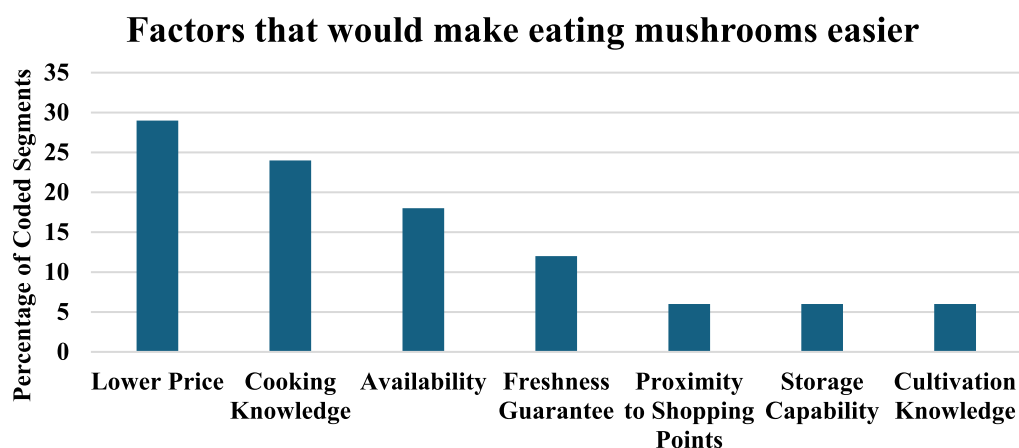


FIGURE 5
Factors that would make it easier to eat mushrooms (n = 32).

generally less concerned about environmental sustainability in their food choices, they were nonetheless able to articulate what they consider as sustainable and unsustainable foods, focusing on food packaging, food transportation and food waste as the main origins of food related sustainability challenges. As already evidenced in literature, food security and food sustainability are increasingly intertwined (El Bilali et al., 2019). To enhance the resilience and sustainability of food systems, it is thus paramount to increase consumer awareness. While several studies established the rising demand for sustainable foods in high income countries (Alae-Carew et al., 2022; Upright, 2023; Vanhonacker et al., 2013), previous research suggests diets are increasingly environmentally unsustainable in Sub-Saharan Africa (Holdsworth et al., 2023).

As one example of healthy and environmentally sustainable foods, mushrooms and mushroom-blended products have recently gained momentum worldwide, with global production levels expected to reach approximately 21 million tons by the year 2026 (Navarro-Simarro et al., 2024). Yet, a substantial number of respondents stated to be unaware of both their palatable characteristics, as well as the nutritional benefits. Lack of knowledge and awareness was also previously reported by the findings of De Cianni et al. (2023), who suggested that new strategies were needed to increase consumers' familiarity with mushroom products. Similarly, Predanócyová et al. (2023) highlighted that a lack of awareness was among the limiting factors of edible mushroom consumption among Slovak Consumers. In Iran, it was also found that familiarity with the King oyster mushroom had a positive and statistically significant effect on the probability of consumption (Shadlousofla et al., 2021). Therefore, the results of this study also highlight the importance of raising consumer awareness and knowledge about

edible mushrooms. Such efforts could emphasize the ecological and nutritional importance of eating mushrooms, as well as the benefits on human health. It is important to counter misconceptions and popular beliefs that mushrooms are to be eaten by children or sick people as some of our respondents suggested. While it is true that children and people with comorbidities would greatly benefit from mushroom consumption, some participants tend to use that argument as a reason not to eat mushrooms in relatively healthy individuals.

Among the barriers to mushroom consumption, participants included the distance to the nearest markets. This is particularly important because public transport is not so reliable and adds extra cost to the price of mushrooms. As shown in Figure 6, mushrooms are generally sold at a vegetable stand in major markets like Kimironko, Ziniya, Nyabugogo (kwa mutangana), and Nyarugenge. These markets may not be accessible to households living far from the commercial centers since they are mostly located in areas with booming economic activities. These results corroborate earlier findings of (Bulto et al., 2022; Stadlmayr et al., 2023), who concluded that the barriers to fruit and vegetable consumption were poor access, cost and sociocultural factors.

Moreover, cultural beliefs were reported as a major impediment to edible mushroom consumption in Kigali since it was traditionally not acceptable to eat mushrooms in cattle farming households. While some respondents stated that they personally appreciated mushrooms for their taste and nutritional importance, most highlighted the negative socio-cultural beliefs from their acquaintances, friends, peers, neighbors and colleagues. These results are congruent with the findings of De Cianni et al. (2023), who argued that mushroom consumption is largely influenced by cultures of different countries and remains a controversial food.



FIGURE 6
Mushrooms for sale in Kimironko market, Kigali (Photo credit: Author, June 12th, 2023).

In this study, several factors have emerged that might have the potential to enable participants to consume mushrooms in their diet, namely, proximity to mushroom purchasing points, having adequate storage capabilities, cultivation knowledge, freshness guarantee, market availability, mushroom cooking knowledge and cheaper prices. In addition to price, which ranks first with approximately 30% of the coded segments, mushroom cooking knowledge and freshness guarantee deserve policy makers and other stakeholders' attention. While price deterrence could be attenuated by putting greater emphasis on mushrooms' unique taste, their nutritional and medicinal benefits, it appears that mushroom producers would increase sale volumes by improving the quality of produces and ensuring they remain fresh. Since mushroom consumption runs counter current with cultural norms and traditions, especially in traditionally cattle keeping communities, it is of no surprise that commercialization and consumption of mushrooms is still relatively new, and many households have no mushroom cooking experience. Consistent with earlier findings of [Giacomuzzo et al. \(2024\)](#) who suggested that developing self-efficacy through knowledge and skills would promote vegetable consumption, efforts to sensitize and educate the public on cooking knowledge and practices should be undertaken to develop the mushroom industry.

6 Limitations

Although it was appropriate to have recourse upon exploratory approaches to elicit information on a topic where little to no information existed, the data presented herein solely rely on personal views and opinions of participants and may not necessarily reflect views and perceptions of the entire urban population in Kigali. This notwithstanding, however, several measures were taken to minimize possible bias. The FGDs were supplemented with individual, in-depth interviews, which presumably helped mitigate the influence of gender, social and power dynamics. The FGDs were also categorized into older adults and young adults with food decision making possibilities to include all age sensitive perspectives in the analysis. Moreover, through triangulation, data was analyzed collectively by all authors to avoid subjectivity and bias. To enhance credibility, the codes and categories were discussed among the research team to reach consensus, and a coding framework was established in an iterative manner. Moreover, a reflexive journal was kept during the entire data collection process to track and check for authors' biases and assumptions, mainly focusing on positionality. Innovative interview techniques such as role play and small group discussions during FGDs were employed to discover participants' real feelings and meanings, a method which, we are confident, has eliminated social desirability and attenuated the researcher-researchee boundaries by allowing group members to freely interact and write their responses without prejudice or researcher interference.

Lastly, although we used the NEP scale heuristically to guide discussion rather than for quantitative measurement, we adapted its application to the local context by translating selected items into Kinyarwanda and simplifying the content where appropriate. As described in the methodology, additional clarifications were provided during focus groups to support participants' understanding. Even with these adjustments, we interpreted findings on ecological mindedness with caution, given the abstract nature of NEP concepts and the varying levels of formal education and language fluency among participants. We recommend that future studies similarly tailor

ecological attitude tools to the linguistic and educational backgrounds of their target populations, especially when adapting NEP items across cultural settings ([Ogunbode, 2013](#); [Neto et al., 2021](#)).

7 Research and policy implications

This study explored consumers' knowledge, awareness and attitude towards healthy and sustainable eating practices. As the results indicate, healthy and sustainable eating practices could be enhanced by increasing availability and affordability. In some cases, strategies to enhance awareness such as public sensitization could also play a role in boosting healthy consumption. For instance, it has been found, in this study, that grown-ups, especially men overlook the importance of fruits and do not consider eating them appropriate in Rwanda's cultural context (see section 4.2). In the current context of mounting food prices, it is also not straightforward whether women eat fruits, as recent evidence suggests prioritizing children in poor households ([Kalle and Muller, 2024](#)). Efforts to encourage healthy diets and fruit consumption should thus target both men and women. As almost all respondents could not easily associate environmental sustainability with food and dietary practices in this study, environmental education programs incorporating this aspect are essential to build sustainable food systems.

The study also sought to identify the bottlenecks to mushroom consumption in Kigali. Price, cultural beliefs, limited availability and inadequate cooking skills were reported as the major barriers to increased mushroom consumption among others. While efforts aimed at increasing mushroom consumption in Kigali should consider these factors, follow up studies using quantitative methods of analysis are highly recommended to generalize findings to the whole population, and to inform policymakers and stakeholders in the mushroom industry on actionable measures to enhance mushroom consumption in the country.

8 Conclusion

This study has explored consumers' knowledge, awareness and attitude towards healthy and sustainable consumption in Kigali, Rwanda. Respondents suggested that healthy diets should be characterized by plenty of vegetables and fruits intake, although meat is still regarded with high esteem. Traditional foods such as cassava, sweet potato, rice, as well as vegetables like amaranth, beans, and carrots were regarded as healthy foods, while unsustainable foods were perceived as mainly those with excessive packaging and plastic packaging. In either FGDs or IDIs, neither sustainability nor health appear to be the main concern for consumers while making food decisions. Households were more concerned about the ability to access affordable and sufficient food. The price of food has emerged as the main point of concern in both FGDs and IDIs, while food rotation and health/nutritional aspects come thereafter.

The present study has also undertaken to understand the perceptions and attitudes of urban consumers towards edible mushrooms as one example of a healthy and sustainable type of food being promoted by the Rwandan government. Respondents' views and attitudes appear nuanced. There are those that look to mushrooms with contempt and negative feelings, and those who regard them with high esteem and consideration. In most cases, knowledge and awareness remain central in shaping consumer attitudes towards

edible mushroom consumption. Although there is an increasing recognition of mushrooms as healthy and delicious foods, there still exist some social misconceptions and beliefs that jeopardize wide scale adoption. For instance, it is still common to assume that mushrooms are special for poor people in villages, or that they are predestined to those with malnutrition and, or chronic diseases.

Additionally, participants reported improving knowledge and skills in preparing mushroom-based meals, along with lower market prices, as one of the leading factors to enhance their ability to frequently eat mushrooms. Participants also indicated that mushroom availability was not guaranteed at the market. Although mushrooms grow in cultured environments, humidity levels required are hardly attainable in summer for many small producers, making fresh mushroom products scarce at the market. It is thus important to enable farmers to ensure the supply of fresh mushrooms to consumers in need, regardless of the season.

Data availability statement

Data will be made available upon reasonable request addressed to Felix.Ndayisaba@ag.uni-giessen.de.

Ethics statement

The studies involving humans were approved by Protestant University of Rwanda and National Institute of Statistics of Rwanda. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

FN: Investigation, Formal analysis, Writing – review & editing, Writing – original draft, Funding acquisition, Methodology, Visualization. MH: Writing – original draft, Methodology, Investigation, Validation, Writing – review & editing. FU: Writing – review & editing, Investigation, Methodology, Writing – original draft, Validation. RT: Resources, Funding acquisition, Validation, Writing – review & editing, Conceptualization, Supervision, Writing – original draft, Project administration.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2025.1612325/full#supplementary-material>

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