

# Organoleptic qualities of products derived from two ecotypes of tiger nut (*Cyperus esculentus*) cultivated in Niger.

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**Keywords**— *tigernut tubers, processing, derivative products, organoleptic quality, Maradi, Niger.*

**Abstract**— *Despite the development of tiger nut cultivation in Niger, the potential of its tubers remains underutilized. The present study was conducted in this context, with the aim of promoting these tubers in Niger. The study began with the collection of two ecotypes of tiger nuts in Tchadoua and Chadakori in the Maradi region. The ecotypes were then processed into flour, milk, and cookies at the Research Laboratory for Hygiene, Food Science, and Nutrition at the Faculty of Agronomy in Niamey. A panel of ten people evaluated the organoleptic quality of each product. The study concluded that there was a strong preference for products made from unsoaked large tiger nuts, particularly flour and milk. For the milk products, this preference was based on color (E4), taste (E12), smell (E10), and consistency (E2). The most popular products were the baked cookies and "dakoua" E1, which were made from 100% tiger nuts and accepted by the panelists. This study may therefore contribute to diversifying tiger nut products and developing the sector economically.*

## I. INTRODUCTION

*Cyperus esculentus* L., commonly called the "sweet nut," is a perennial plant that grows from rhizomes and tubers. Cultivated species are often annuals. It belongs to the *Cyperus* genus of the Cyperaceae family and spreads entirely through underground tubers. It is also known by various names, such as yellow carbide, tiger nut, chufa, underground chestnut, marbale, underground walnut, ground almond, ginseng fruit, sweet pea, and "thiogon" (Sembé *et al.*, 2019 ; Zhang *et al.*, 2022). In Niger, tiger nut cultivation is the third most valuable export crop in terms of foreign exchange earnings after onions and cowpeas (GOMBO, 2005). It can contribute over 500 million CFA francs per year to small-scale producers' incomes (Aoua *et*

*al.*, 2008). Although tiger nut cultivation is growing, there are few studies on this product (BORI, *et al.*, 2018). Tiger nuts are one of the few tubers with a high fatty acid content (25.2 g per 100 g of raw tiger nuts) and are notable for their high fiber content (Haoua *et al.*, 2023). The skin of the tuber contains most of the insoluble fiber (11.2 g per 100 g of peeled tiger nut compared to 33 g per 100 g of unpeeled tiger nut). Tiger nuts also contain high-quality vegetable protein with essential amino acids, such as arginine, leucine, and lysine (Dupont, 2023). Tiger nuts are rich in vitamins E and C, as well as minerals and trace elements such as phosphorus, calcium, potassium, magnesium, iron, and zinc. They are a real source of energy, providing 549 kcal per 100 g of raw tiger nuts. In Niger, tiger nuts are used in

various forms in human food (cookies, candies, flour, milk, etc.) (Bori, *et al.*, 2018). Like most tubers, tiger nuts help combat malnutrition thanks to their chemical composition, medicinal properties, and anti-inflammatory and anti-apoptotic effects (Ban-Koffi et al 2005; Yali Yu *et al.*, 2022) Traditional processing methods for tiger nut tubers include soaking and roasting (salted or sweetened), making biscuits called "dakoua" (flour mixed with sugar), and making a juice called "nono aya" (Bori, *et al.*, 2018, Adjahossou *et al.*, 2021). This study aims to evaluate the organoleptic quality and acceptability of tiger nut-derived products.

## II. MATERIALS AND METHODS

### 2.1 Study Setting

Tigernuts were collected in the Maradi region, specifically in the Tchadoua and Chadakori municipalities, which are located in the Aguié and Guidan Roudji departments, respectively (figure 1). The experimental site for processing tiger nut tubers is the Laboratory for Research in Hygiene, Food Science, and Nutrition (LARHSAN) at the Abdou Moumouni University Faculty of Agronomy in Niamey.

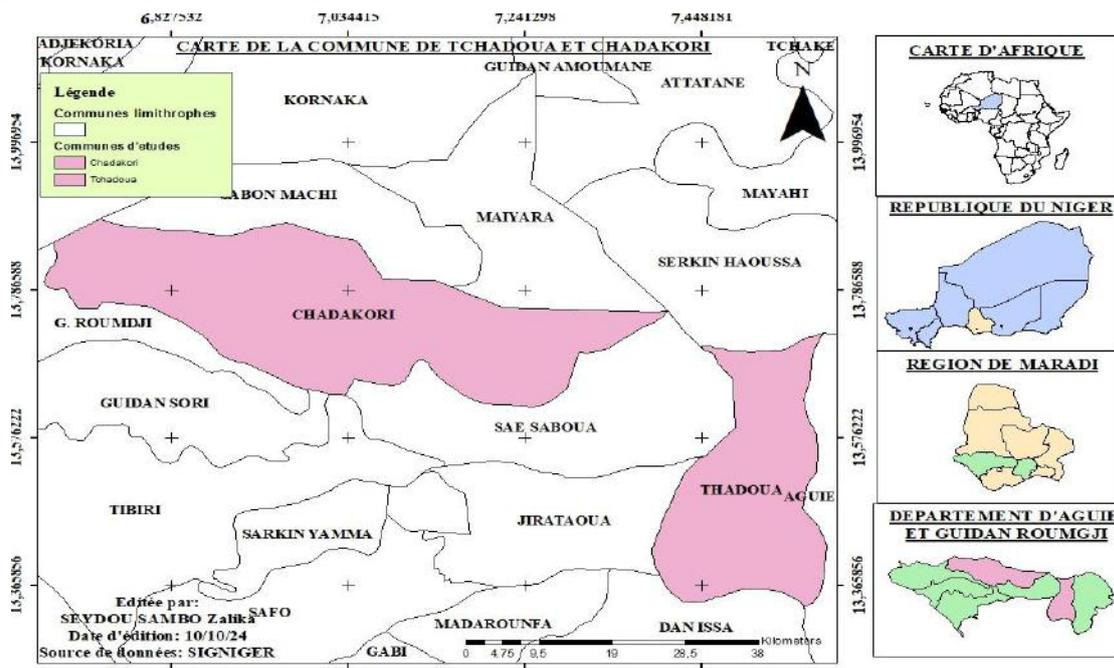


Fig.1: Map of the Tchadoua and Chadakori collection area

### 2.2 Plant Material

The plant material used in this study consists of products derived from large (GTN) and small (STN) tiger nuts produced in the laboratory, including tiger nut flour, cookies, dakoua, milk, and porridge (Figure 2).

### 2.3. Sensory Analysis Procedure and Data Processing

The sensory analysis was conducted at the Laboratory for Research in Food Hygiene and Nutrition (LARH-SAN). A tasting panel of ten people was selected at random for each tiger nut product based on the inclusion criterion of regularly consuming tiger nuts. The organoleptic testing of

tiger nut products required the following equipment: - Small boxes with spoons for flour and porridge

- Small disposable cups for milk
- Plates for Dakoua and Cookies
- A glass of water for each taster to rinse their mouth

Data processing and percentage calculations were performed using Microsoft Excel software. Data processing and percentage calculations were performed using Microsoft Excel.



	Flours	Cookies	"Dakoua" Cookies	Milks	Boiled products
<b>C</b> Derivative products					

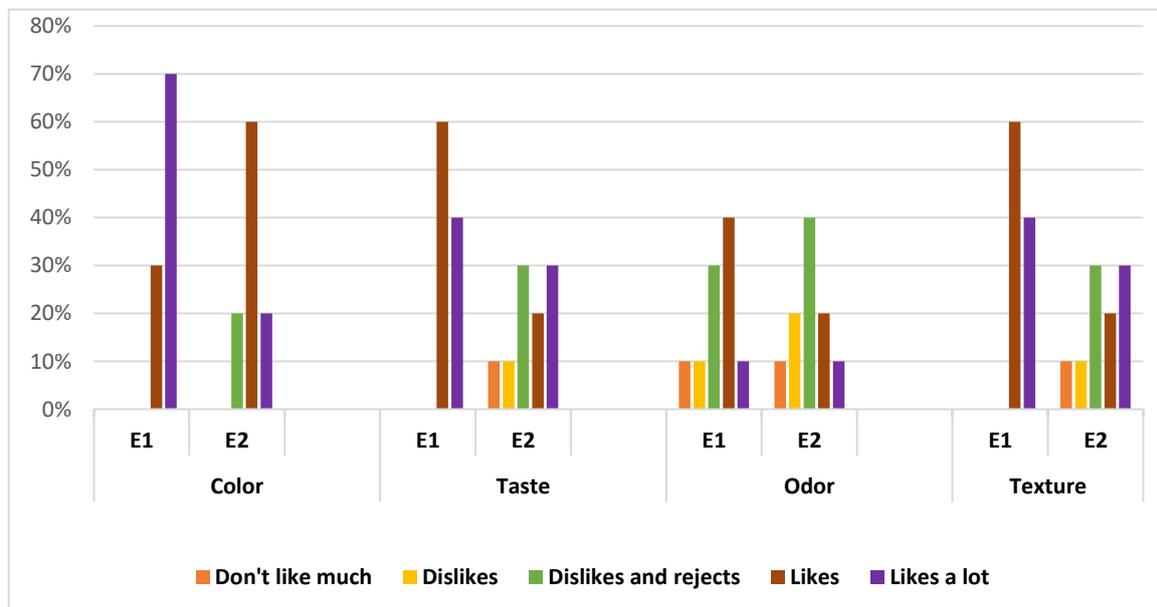
Fig.2: A. Small nut, B. Large nut, C. Derivative products studied

### III. RESULTS AND DISCUSSION

#### 3.1. Results

##### 3.1.1. Assessment of the Organoleptic Parameters of Tiger Nut Flours

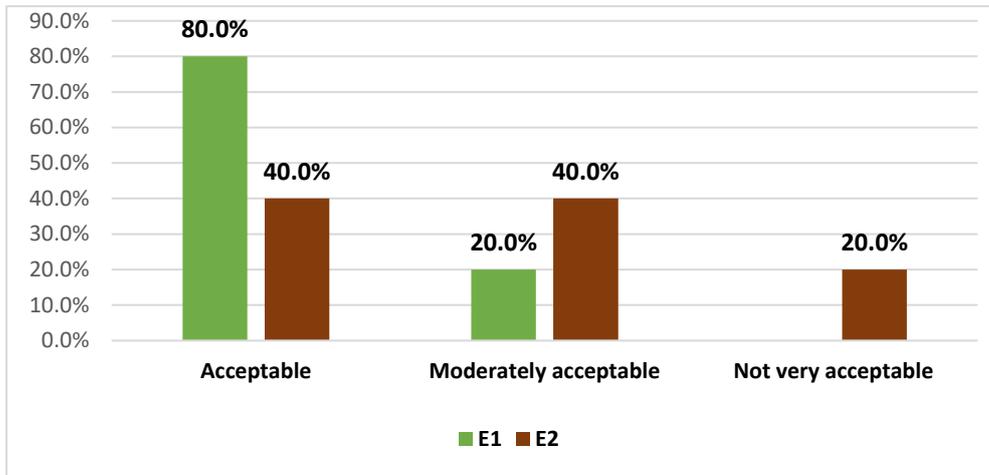
Figures 3 and 4 show the organoleptic test results and acceptability of flours from the two types of tiger nuts grown in Niger, respectively.



E1 is large tiger nut flour and E2 is small tiger nut flour.

Fig.3: the assessment of the organoleptic parameters of the flours from the two types of tiger nut.

The large and small tiger nut flours received a "Like very much" rating of 70% for color from the panelists. In terms of taste and texture, E1 received a higher rating (60%) by the panelists with the rating "Like" and finally, regarding the smell, 40% respectively for the ratings 'Like' and "Don't like and don't dislike" for samples E1 and E2.



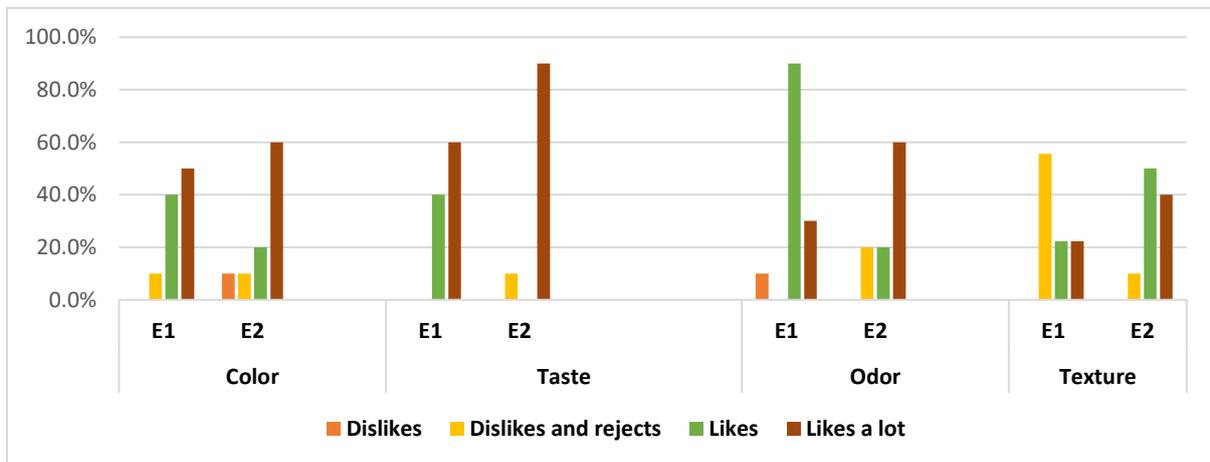
E1: Large tiger nut flour E2: Small tiger nut flour

Fig.4: acceptability of the flours from the two tiger nut ecotypes.

The analysis shows that 80% of tasters found E1 "acceptable," 40% found E2 "moderately acceptable," and 20% found E2 "unacceptable." Overall, the sensory analysis results show that large tiger nut flour is the most acceptable.

### 3.1.2. Assessment of the Organoleptic Parameters of Tiger Nut Cookies

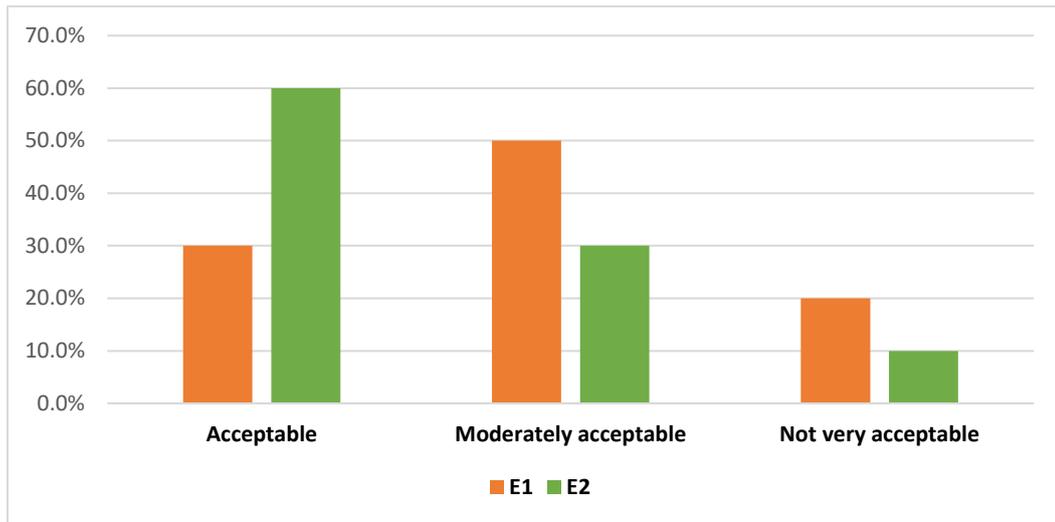
Figures 5 and 6 show the organoleptic test results relating to color, taste, smell, texture, and the acceptability of tiger nut Cookies fried in oil and baked in the oven.



E1: Oil-fried biscuit E2: Oven-baked biscuit

Fig.5: assessment of the color, taste, smell, and texture of tiger nut cookies.

Figure 5 shows that sample E2 was the most appreciated in terms of taste and color. Ninety percent of panelists chose the "like very much" option for taste, and 60% chose the same option for color. In terms of smell, 90% of the panelists preferred sample E1, and 60% "really liked" the smell of the baked cookies. However, 55.6% did not appreciate the texture of the oil-fried cookies.



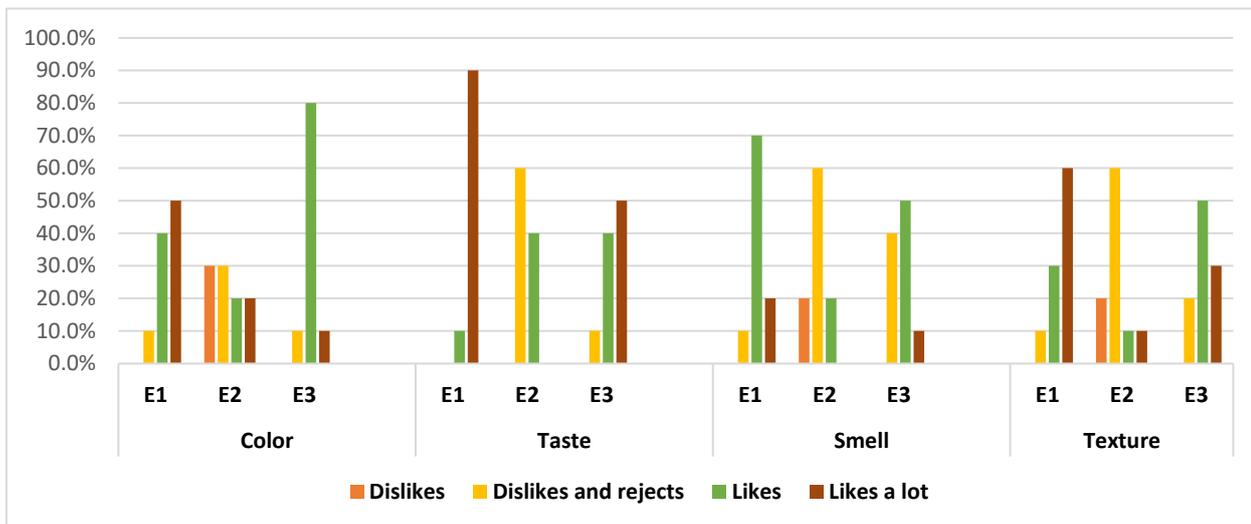
E1: Oil-fried biscuit. E2: Oven-baked biscuit.

Fig.6: Acceptability of the oil-fried and oven-baked cookies.

Analysis of Figure 6 shows that 60% of panelists rated cookie E2 as "acceptable," 50% rated cookies E1 as "acceptable," and 20% and 10% rated cookies E2 and E1 as "moderately acceptable" and "not very acceptable," respectively.

**3.1.3. Assessment of the organoleptic parameters of the different “Dakoua” variants produced.**

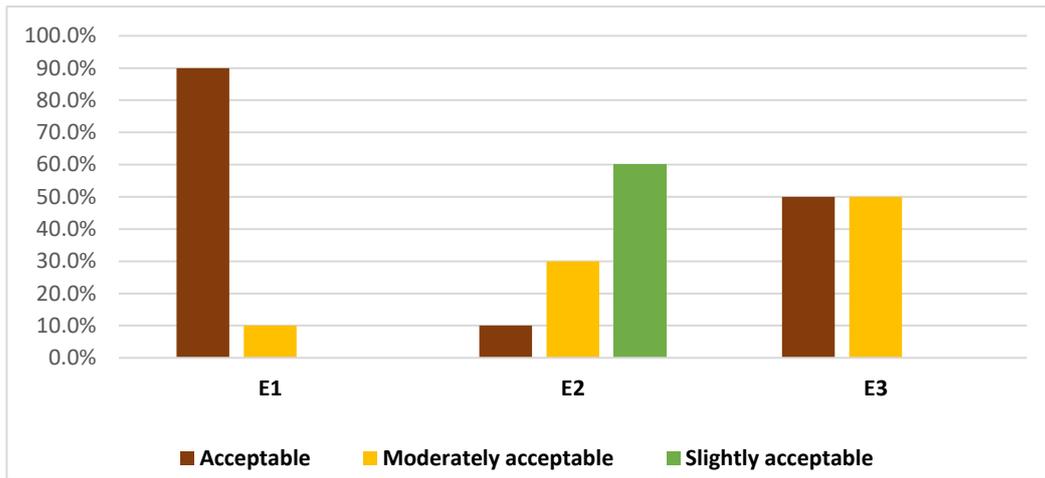
Figures 7 and 8 show the results relating to color, taste, smell, texture, and acceptability.



E1: 100% tiger nut “Dakoua”; E2: 85% tiger nut, 15% millet “Dakoua”; E3: “Dakoua” with 90% tiger nuts and 10% milk.

Fig.7: Assessment of the color, taste, smell, and texture of the different variants of “Dakoua.”

The analysis shows that E3 was the most popular in terms of color, with 80% of panelists choosing the "like" option. In terms of taste and texture, 90% and 60% of panelists, respectively, chose the option “like very much” for E1 and E3, while 60% of panelists chose the option “don't like and don't reject” for E2. Panelists also preferred the smell of E1 and E3, with 70% and 50%, respectively, choosing "like." E1, made from 100% tiger nuts, was the most popular “Dakoua,” while E2, made from a mixture of tiger nuts and millet, was the least popular.



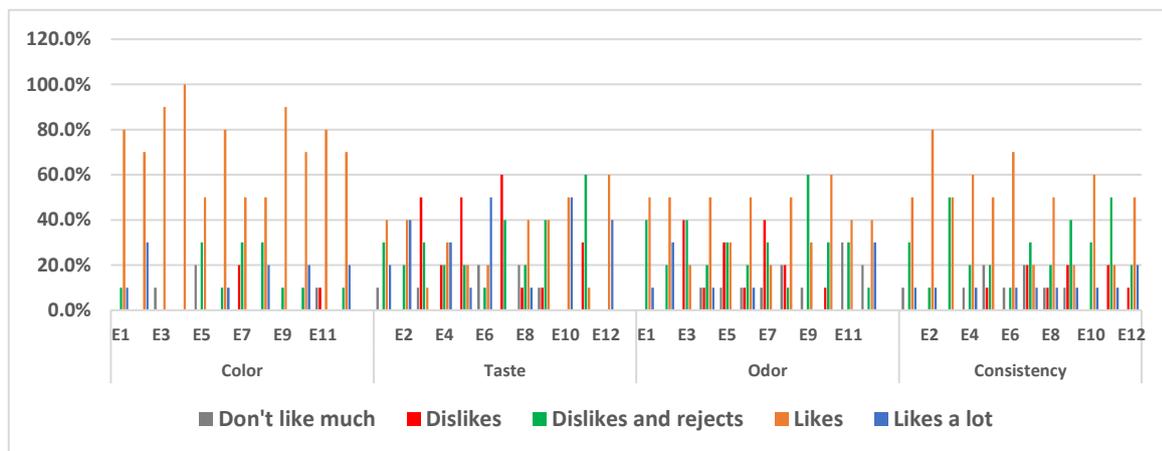
E1: "Dakoua" made from 100% tiger nuts; E2: "Dakoua" made from 85% tiger nuts and 15% millet; E3: "Dakoua" 90% tiger nut and 10% milk.

Fig.8: Acceptability of the different "Dakoua" variants.

Analysis of Figure 2 shows that 90% and 50% of the panelists rated E1 and E3 as "acceptable," respectively, while 60% rated E2 as "not very acceptable." In summary, the results of the sensory analysis show that variants based on 100% and 90% tiger nuts are the most accepted.

### 3.1.4. Assessment of the organoleptic parameters of tiger nut milks

Figure 9 shows the assessment of the color, taste, smell, and consistency of the different types of milk made from small tiger nuts (PS) and large tiger nuts (GS).



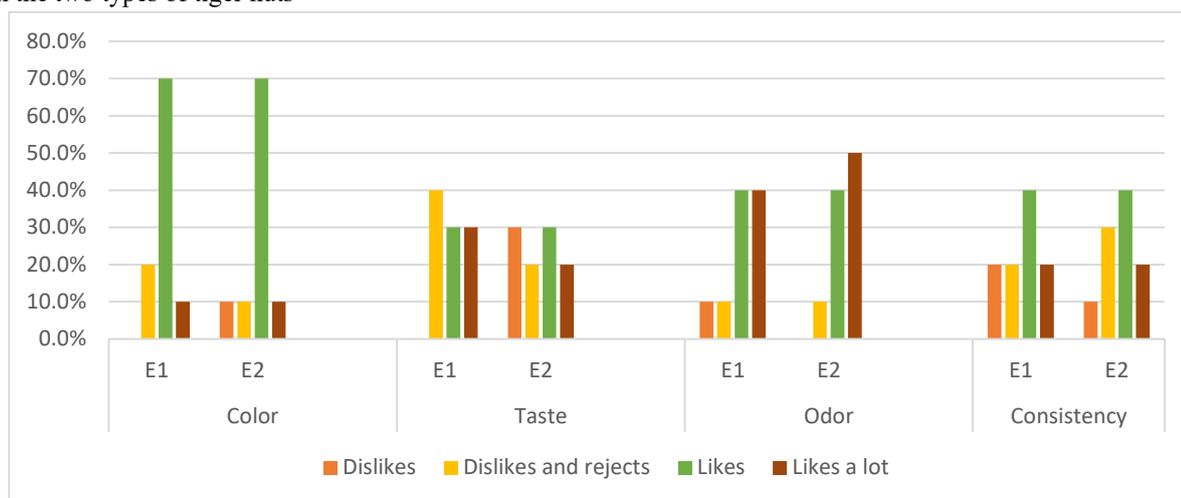
E1: unsoaked small tiger nut milk; E2: unsoaked large tiger nut milk; E3: soaked small tiger nut milk; E4: soaked large tiger nut milk; E5: unsoaked small tiger nut milk, steamed; E6: unsoaked large tiger nut milk, steamed; E7: unsoaked small tiger nut milk, blanched; E8: unsoaked large tiger nut milk, blanched; E9: soaked small tiger nut milk, blanched; E10: soaked large tiger nut milk, blanched. Steamed soaked small tiger nut milk; E8: steamed soaked large tiger nut milk; E9: unsoaked small tiger nut milk, blanched; E10: unsoaked large tiger nut milk, blanched; E11: blanched soaked small tiger nut milk; E12: blanched soaked large tiger nut milk.

Fig.9: Assessment of the color, taste, smell, and consistency of the different small tiger nut (STN) and large tiger nut (LTN) milks.

Figure 9 shows that more than 50% of panelists appreciated the color of all derivative products, with E4 soaked tiger nut milk receiving the most mentions, followed by 100% for all other products. E6, E10, and E12 milks were the most appreciated by the panelists for their taste, with mentions of "really like" and "like," compared to E3, E5, E7, and E11 milks, which were rated "don't like" and "don't like and don't reject." The analysis also shows that E10 milk (60%) has the most pleasant smell, while E9 milk (60%) has the least pleasant smell. Of the milks evaluated, E7, E9, and E11 are the least consistent. According to the analysis results, tiger nut milks are the most appreciated in terms of color (E4), taste (E12), smell (E10), and consistency (E2).

### 3.1.5. Assessment of the Organoleptic Parameters of Tiger Nut Porridges

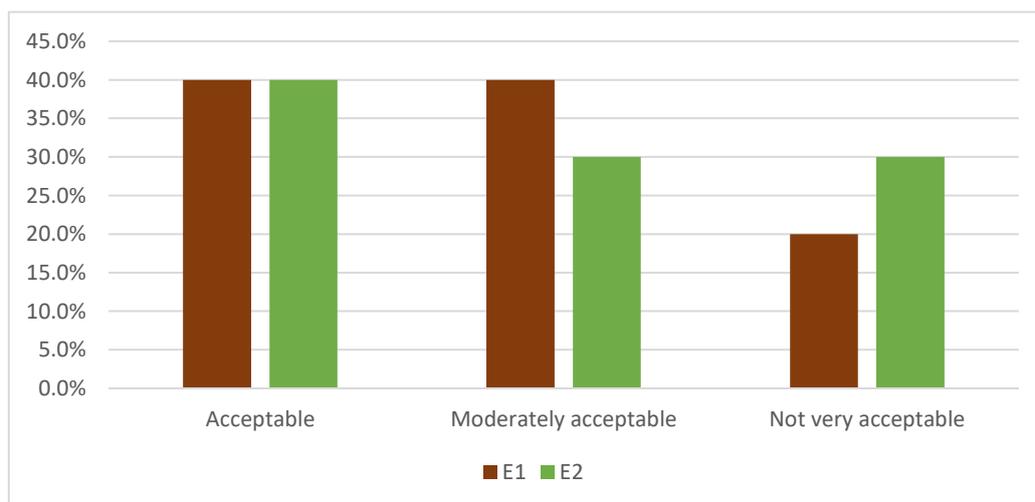
Figures 10 and 11 show the organoleptic test results relating to color, taste, smell, texture, and acceptability of porridges made from the two types of tiger nuts



E1: large tiger nut porridge, and E2: small tiger nut porridge.

Fig.10: Assessment of the color, taste, smell, and consistency of the porridges made from the two tiger nut varieties.

Analysis of Figure 10 shows that the panelists much preferred the color of porridges E1 and E2, with 70% rating them as "like." In terms of smell, 50% of the panelists much preferred E2.



E1: large tiger nut porridge, and E2: small tiger nut porridge.

Fig.11: Acceptability of porridge made from the two varieties of tiger nuts.

Figure 11 shows that 40% of the panelists found E1 to be acceptable or moderately acceptable, while only 20% found it to be unacceptable. These results show that E1 porridge is more acceptable than E2 porridge.

#### IV. DISCUSSION

Sensory analysis reveals a clear preference for products made from large tiger nuts, especially flours and milks. This can be explained by the organoleptic qualities of large tiger nuts. Their fine texture and milder taste make them more suitable for preparations such as cookies or porridge.

Panelists rated the products made from tiger nuts differently according to the sensory parameters considered in the assessment and acceptability test. Large tiger nuts (GS) were preferred by the panelists for their color, taste, and texture. Seventy percent rated them as "like very much" for color, and 60% did so for taste and texture. Overall, 80% of the panelists found GS to be acceptable. This could be explained by their whitish color and high total sugar content ( $10.28 \pm 0.08\%$ ) and reducing sugar content ( $4.21 \pm 0.66\%$ ) (Kadjo et al, 2023).

The oven-baked cookie (E2) was the most popular due to its taste and color, receiving 90% and 60% ratings,

respectively. It also received the highest overall acceptability rating, at 60%, compared to 30% for E1. This could be explained by the fact that the product is less fatty than the oil-fried cookies. This result is similar to that of Belmadani, N. et al., 2024 who found that sensory testing of freshly stored cookies revealed that most tasters preferred baked tiger nut flour cookies.

The "Dakoua" made with 100% tiger nuts (E1) and 90% tiger nuts and 10% milk (E3) were the most popular, particularly for their taste and smell. Product E2 (85% tiger nut and 15% millet) was the least popular, with 60% of the panelists finding it unacceptable. This could be because these two products meet local consumers' expectations regarding richness and satiety. Tiger nut flour has a considerably higher sucrose concentration (15 g/100 g dry basis) than glucose and fructose, which confirms its natural and desirable sweetness (Belmadani, N. et al., 2024).

Tiger nut milks are the most popular in terms of color (E4), taste (E12), smell (E10), and consistency (E2). This is due to the high sucrose content of tiger nuts, which is appealing to consumers, as well as the higher protein, polyphenol, and mineral content of tiger nut milks (Hernández-Olivas et al., 2022; Zhang et al., 2023)

Panelists prefer large (GS) and small (PS) tiger nut porridges for their color (70%) and smell (50%), respectively. This may be because the white color and smell of tiger nuts are released in the porridge.

## V. CONCLUSION

Sensory analyses have shown that products made from large tiger nuts are the most popular and widely accepted. For milks, that it is the color (E4), taste (E12), smell (E10), or consistency (E2). Baked cookies and "dakoua" E1, which is 100% tiger nut, are the most appreciated and accepted by panelists.

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