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Bread characteristics and descriptive analysis of taro (*Colocasia Esculenta,* Cv *Fouê*): Wheat composite breads and some fritters

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Abstract
Bread characteristics showed that, the specific loaf volume decreased significantly ($p<0.05$) with increasing taro flour substitution. The highest specific loaf volume of 6, 45±0,24 cm3/g were observed in 100% wheat bread compared to the lowest values of 4,24±0,27 cm^3/g observed in 12% taro-wheat composite bread. The sensory evaluation showed significant ($p<0.05$) differences in sensory attributes of taste (aroma and flavor), crust color, texture and acceptability between the 100% wheat and 12% taro-wheat composite breads. This study has shown that the use of taro flour in bread making is feasible and that incorporation of up to 12% of the fouê flour into wheat flour produced acceptable bread with similar taste and aroma comparable to 100% wheat bread.

Keywords: taro, bread, *Colocasia esculenta*, fritters

1. Introduction
Tubers and roots are an important food source for many people in the world (FAO, 2007) [7]. In developing countries (DC), many people in rural areas consume them. These tubers and roots include the taro.
Taro (*Colocasia esculenta* L. Schott) is a monocotyledonous plant belonging to the Araceae family. It is cultivated in all tropical regions. According to Bell *et al*. (2000) [4], most of the cultivated areas are in Africa (Nigeria, Ghana, Ivory Coast ...). Taro is a food that can turn into a series of similar foods to those described for cassava and yam such as porridge, fried, fu, pounded, fritters, spicy soup, sweet soup, paste or ball (Hong *et al*., 1990; Njintang *et al*., 2000) [9].
Its use in technology, particularly in the field of baking and pastry in Ivory Coast would be a major challenge for the country. Indeed, sub-Saharan Africa suffers from excess usage problem of wheat for bread making. That is why, in recent decades, the partial substitution of wheat flour with other flours is of interest to researchers. Many works that address flour made wheat and other products have been made by some researchers (Ikpeme *et al*., 2010; Mongi *et al*., 2011; Diallo *et al*., 2015) [10, 14, 5].
Furthermore, taro, cassava, plantain and other tubers were reported as alternative sources of key raw materials for making bread (Mepba *et al*., 2007; Eddy *et al*., 2007) [13, 6]. This suggests that, opportunities and support for the use of taro flour for the production of baked goods, if possible help to reduce the dependence of developing countries on imported wheat. Therefore, this study aims to evaluate some sensory attributes of wheat bread compounds-and taro fritters with different substitution levels for human consumption.

2. Materials and Methods
2.1 Material
Taro corms of *Colocasia esculenta*cv fouê physiological Maturity were harvested from a farmer field in the town of Affery precisely in the department Akoupé located southeast of the Ivory Coast. This is particularly corms cultivars with violet chairs trade name "Foué" local language "Akyé" in Ivory Coast. They were then transported the day after the place of harvest to the Laboratory of Biocatalysis and Bioprocessing of the Training and Research Unit in Science and Food Technology Université Nangui Abrogoua (Abidjan, Ivory Coast) in jute bags.

Fig 1: Taro corms of *Colocasia esculenta*cv fouê

2.2 Methods

2.2.1 Preparation of taro flour

The freshly harvested taro corms were thoroughly rinsed with water tap and then peeled. Peeled corms were thoroughly rinsed with tap water and are sliced using ainoxydable. The steel knife slices were plated on aluminum foil at room temperature (28 ° C) for 20 min and deposited in an oven at forced convection air to a drying process for 48 hours at 45 ± 2 ° C. After drying, the chips were ground in a Blendor type of hammer mill. The ground material obtained was sieved through a 100 µm mesh sieve. The flour obtained was sealed in polyethylene bags and stored at 25 ° C in a desiccator until use.

2.2.2 Preparation of taro-wheat composite flour

Taro-wheat composite flour was processed by blending wheat and taro (*Colocasia Esculenta*, Cv *Fouê*) flours. Predetermined proportions of 1, 3, 6, 9 and 12 part by weight of taro flour mixed with 99, 97, 94, 91 and 88 part by weight of wheat flour to obtain 1, 3, 6, 9 and 12% of taro-wheat composite flour respectively. 100% wheat flour was used as a control bread sample. The flours were packed in polythene bags and stored at 25 ° C in a desiccator until use.

2.2.3 Bread making

Control breads PT and composite PC (PCF1, PCF3, PCF6, PCF9 and PCF12) were made according to standard method of Amani and Takano (1998) [2].

Different ingredients (flour, improver, yeast, water) except salt were kneaded. Five (5) minutes after the start of mixing, salt, previously diluted in water, was added to the remaining mixture. The kneading time was 25 minutes. The resulting paste was removed from the mess and placed on the weighing table. Four point two (4.2) kg of the slurry was introduced into a divider to be in turn subdivided into twenty (20) tranches. The slices were in turn introduced into a moulder to give a desired shape by the experimenter (long). The dough pieces obtained were spread on benches so they lifted about 3 hours and a half to finish. Once removed, the dough pieces were deposited on the baton to kiln where they were spangled with tracer before being placed in an electric oven to be cooked for 20 minutes at 250 ° C. Baked, the loaves are left at room temperature for cooling: it is bleeding above the determination of bread characteristics (loaf specific volume), as well as sensory attributes like crust colour, taste, aroma, texture, cumb and general acceptability.

2.2.4 Fritters making

Donut preparations have been made according to the method of Soudy (2011) modified. The different ingredients (flour, salt, yeast, sugar) were mixed well in an amount of water to form elastic paste. Then let rested in a pot about 2 hours to allow fermentation and swelling. Frying was done in oil previously hot for five (5) minutes. Out of the frying oil and drained, the donuts are left at room temperature.

2.2.5 Evaluation of bread characteristics

The specific loaf volume was determined according to the method of Méité *et al*., (2008).

$$Vsp\ (cm^3/g)=V\ (cm3)/\ m\ (g)$$

With

Vsp = Specific volume

V (cm^3) = Average length x average width x average height

m: mass of bread stick

2.2.6 Sensory evaluation procedures

For the descriptive analysis of food, a trained panel was put in place. Panelists have been selected on the basis of a psycho-technical test and entrained in the descriptive analysis of the organoleptic characteristics of the food. A total of 20 panelists (women) took part in the evaluations. The samples of various dishes were cut into slices of uniform thickness and coded with three (3) digits. These samples identified were presented in random order to the tasters (Watts *et al*., 1991). Descriptive analyzes focused on general aspects such as the color of the crust, texture, aroma, flavor, crumb and general acceptability.

2.2.7 Statistical data analysis

All measurements were performed in triplicate and the resulting data were subjected to analysis of variance. Duncan's test was used to classify treatment in cases where there exists a significant difference. All these analysis were performed using STATISTICA 7.1 software. Statistical significance was set at 0.05.

3. Results and Discussion

3.1 Results

Figure 2 shows the evolution of some organoleptic attributes of different formulations of Foué composite flours. The breads made have significant differences (5%) in the various sensory characteristics assessed.

To the level of the color of the crust, the panelists appreciated the color of the crust of the composite breads on the whole in relation to the control bread.

As for the texture of the crust, the evaluators has all liked the texture of the crust of the composite breads to those of the control bread.

Concerning the aspect of the crumb, we notice that the different crumbs of the composed breads are appreciably identical to the one of the control bread. However, the aspect of the crumb of the FCF12 bread showed a crumb that is not accepted by the set of the panelists.

With regard to the alveolar of the crumb, the panelists observed a regularity of the alveolar in the different composed breads.

The panelists have appreciated the flavor and the aroma characteristics of bread in the composed breads.

In a general way, the composed breads gotten from the composite flours of fouê are accepted extensively by the set of the panelists.

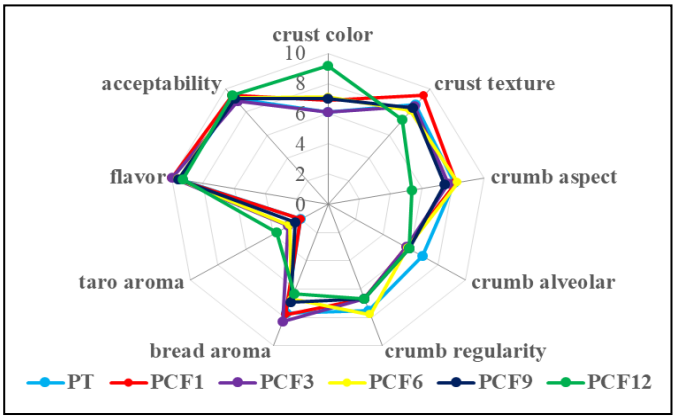

Fig 2: Sensory profiles of the breads control and composedof Foué

- *PT: Stick of bread gotten from the flour of wheat (witness bread)*
- *PCF1: Stick of bread gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 99/1 (p/p)*
- *PCF3: Stick of bread gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 97/3 (p/p)*
- *PCF6: Stick of bread gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê" proportion 94/6 (p/p)*
- *PCF9: Stick of bread gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê" proportion 91/9 (p/p)*
- *PCF12: Stick of bread gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê" proportion 88/12 (p/p)*

Specific loaf volume

Table 1 shows the specific loaf volume of the control bread and compossed bread Foué it is evident from this table that some significant differences exist ($p<0,05$) between the composed breads and the bread witness. These volumes decrease 6.45±0.24 to 4.24±0.27 cm3/g.

Table 1: Specific Loaf Volume

breads	**PT**	**PCF1**	**PCF3**	**PCF6**	**PCF9**	**PCF12**
Specific volume (cm3/g)	6.45±0.24c	6.24±0.23c	5.90±0.67b	5.51±0.29b	5.42^{b}±0.18	4.24±0.27a

Sensory analysis of the fritters

Figure 3 and 4 shows Sensory profiles of the donuts control and composed of Fouê.

The color of the crust of the sugary donuts and donuts without sugar of Fouê is appreciated a lot by all panelists. In the same way, the texture of the crust the donuts composed of Fouê are also appreciated by the set of the panelists. With regard to, the aroma of wheat, statistically meaningful variations to the doorstep of 5% have been observed. This aroma is audible in the different fritters valued by the panelists.

Overall, the sugary fritters and the fritters without sugar are accepted by the set of the panelists. However, the sugary fritters are appreciated better until 12% in relation to the fritters without sugar.

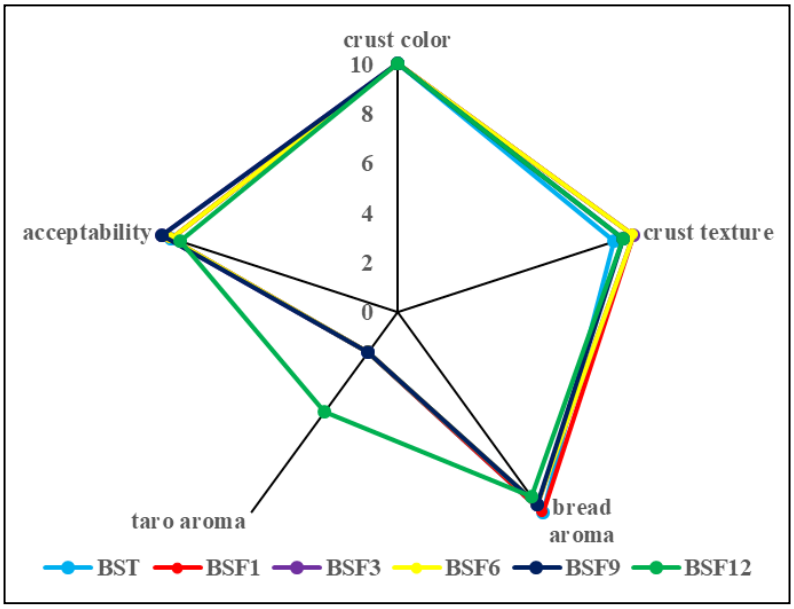

Fig 3: Sensory profiles of the sugary donuts control and composed of Fouê

- *BST: sugary fritter gotten from the flour of wheat (witness sugary fritter)*
- *BSF1: sugary fritter gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 99/1 (p/p)*
- *BSF3: sugary fritter gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 97/3 (p/p)*

- *BSF6: sugary fritter gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 94/6 (p/p)*
- *BSF9: sugary fritter gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 91/9 (p/p)*
- *BSF12: sugary fritter gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 88/12 (p/p)*

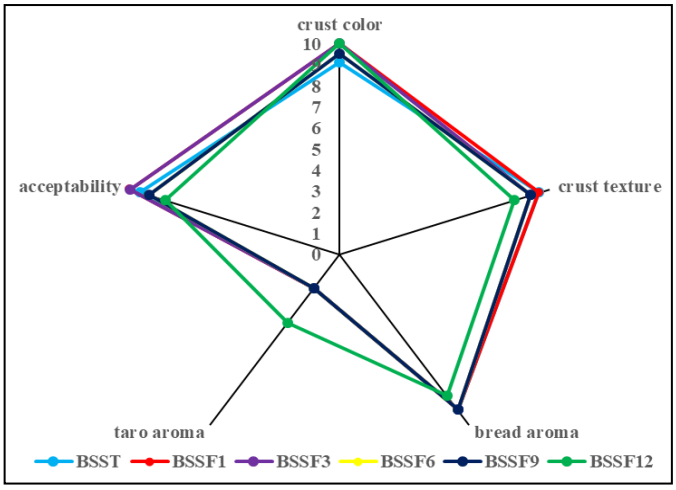

Fig 4: Sensory profiles of the fritters without sugar control and composed of Fouê

- *BST: fritter non gotten from the flour of wheat (witness fritter without sugar)*
- *BSSF1: fritter non gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 99/1 (p/p)*
- *BSSF3: fritter non gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 97/3 (p/p)*
- *BSSF6: fritter non gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 94/6 (p/p)*
- *BSSF9: fritter non gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 91/9 (p/p)*
- *BSSF12: fritter non gotten from the composite flour of wheat and taro corms of Colocasiaesculentacv "fouê", proportion 88/12 (p/p*

3.2 Discussion

The sensory quality is a dimension important of the quality of the total product and is recorded by the senses human of the view, the smell, the taste, the hearing and the touch (Meilgaard *et al*., 1991) [11]. The differences of the color of the crust could explain themselves by the Belgian color of the flours of taro. Indeed, according to Mongi *et al*. (2011) [14], the color of the darker crust can be assigned to the color of the flour of taro. According to these same authors the color of the crust would be besides, due to the reaction of maillard between the reducing sugars and the amino acids of the proteins. Our results are similar to those reported by Mongi *et al*. (2011) [14] and Adeniji (2015) [1].

Breads composed of fouê presented the aroma and the flavor feature of bread. This observation would be due to the contribution of the quantity of the flour of taro. Eddy and al. (2007) [6] showed that the level of supplementation of 10% to 20% doesn't affect the taste of bread. Our breads could have a good appetence for the consumer. Our results corroborate to those of Adeniji (2015) [1].

The aspect of the bread crumb composed PCF12 is not accepted by the panalistes. This remark would be due to the strong quantity of the flour of taro. According to Salmenkallio-Marttila *et al*. (2001) [18] the content in fibers would generally weaken the structure of bread while reducing the volume and the springiness of the crumb. This effect has been assigned to the interaction between the fiber and gluten that would drive to a reduction of the capacity of retention of gas (Gomez *et al*., 2003) [8].

Breads composed of fouêof by their sensory attributes are accepted by the set of the panelists. Our results are in agreement with those of Njintang *et al*. (2008) [16]. According to these authors the incorporation of the flour of taro in the one of wheat had to not pass 10%. However, the substitution of the flour of taro to a level superior to 10% to the one of wheat doesn't affect the quality of bread (Ammar *et al*., 2009) [3].

The specific loaf volume is one of the most important visual features of the bread, influencing the choice of the consumers strongly. According to Shittu *et al*. (2007) [19] the specific volume of bread is a key parameter to value the quality of bread.

The reduction observed to the level of the specific volume of bread would be due to the contribution of the quantity of the flour of taro in the one of wheat. According to Mongi *et al* (2011) [14] the effect of gluten dilution with the addition of the flour of taro to the one of wheat provoked the depression in the specific volume of bread. In the same way, Ndangui *et al*. (2014) [15] revealed in their works that the use of the common hydration of the mixture of the composite flours (wheat /potato) would drive to a dilution of gluten in the mealy environment. Our results are superior to those indicated by Mongi *et al*. (2011) [14] whose values are respectively 4, 3 cm^3/g and 3,5 cm3/g in the flour of wheat and flour composite wheat /taro to 10%.

4. Conclusion

Our results on the sensory attributes of breads composed wheat-taro showed that the addition of the flour of the taro to the one of wheat until 12% gave a bread accepted by the set of the panelists. Therefore the incorporation of flour of the taro in the one of wheat would be therefore a method efficient of reduction of the bread cost and other products drifted as the fritters in Coast of Ivory.

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