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Parkia Biglobosa Fermented (Soumbara) Seeds Using In Breadmaking To Improve Final Bread Quality

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Abstract

The objective of this study was to promote parkia biglobosa (Soumbara) fermented seeds nutritional properties in breadmaking in order to ensure the health of some population. The Soumbara is used at the formulation of breadmaking process. It is that technologically, organoleptically and nutritionally ingredient accepted in breadmaking formulation with a proportion of 1% of Soumbara fermented seeds (PS1), 2% (PS2), 3% (PS3), 4% (PS4) and 5% (PS4) addition in the wheat bread flour. The humidity of the flour is between 13.3%±0.23 and 13.9%±0.03. Falling number Hagberg showed amylase activity of flour between 290s±1.33 and 350s±3.98. The elasticity is the ratio of the dough tenacity (P) and the extensibility (L) varied between 0.72±0.08 and 1.22±0.02. Values recorded for swelling are between 18.5±0.23 and 20.8±0.52. Bakery strength recorded values are between 87x10-4 J±0.23 and 215x10-4 J±2.85. Soumbara breads volume decrease when the proportion of addited Soumbara to wheat flour increases. The resulting crust and crumb of breads become slightly dark coloring when the proportion of Soumbara increases. The protein are between 7.07%±0.02 and 9.23%±0.98. The lipid increase from 0.44%±0.04 to 0.81%±0.03. The ash increase from 2.37±0.01 to 2.52±0.00 and the energy value of breads increase from 253.85Kcal±2.85 to 267.77Kcal±1.90. Sensory analysis revealed a pronounced aftertaste when the quantity of Soumbara increased.

Keywords: Wheat flour, Soumbara powder, bread, formulation, breadmaking

1. Introduction

Spices have always fascinated people because of their perfect scents, flavors and their beneficial effects on the human body. (Birlouez, 2012). These spices are produced from bark, flowers, leaves, bulbs or seeds of plants. They have been used to develop sweet, cordial and tonic remedies and then for food preservation through their antifungal properties (Savin, 2017). Most of them come from India and

Indonesia plants, but others are typical of West Africa plants. Soumbara is a spice derived from the transformation of néré (Parkia biglobosa) Seeds pods. Soumbala comes from a very abundant shrubby legume of the West African sub-region (Bah, 2015). It is frequently used as a flavor enhancer spice for meals by northern Ivory Coast peoples and then for its very popular as a spice in rice and " tô " dishes. It is a source of ultimate nutrients in food manufacturing (Camara, 2016). According to Marjolaine, 2016, Soumbala helps to prevent and fight against arterial hypertension by its regular consumption. It also prevents and reduces certain forms of anemia, strengthens the defenses of the human body immune system. It relieves burns from insect bites, promotes heart activity and can help to prevent goiter. It is also an excellent health boosting. (Marjolaine, 2016).

Most of scientific studies developed on Soumbara have defined nutritional and microbiological aspects as well as the impact of its consumption on health. (Millogo, 2008). However, Soumbara is still underused and underexploited in the food industry and in general in food in which its application has become necessary. So for its valuation and finding its applications in the food industry become more that necessary. . It is also known that spices are regularly tested or introduced in formulations of consumption industrial products to improve their taste, shelf life and as well as others properties(Nout et and al., 2003). Bread is one of the most widely used in industrial food products to convey food ingredients or nutrients, which are essential to human health because the bread is highly prized as food in the world. . According to Bela, 2014, at Ivory Coast, bread is one of the most popular foodstuffs consumed by the population after the rice.). In this work, some applications of Soumbara in bread making would help to reduce some metabolic diseases. It would be necessary to enhance the organoleptic and nutritional qualities of Soumbara of Ivory Coast in standard bread making.

2. Materials and Methods

2.1 Ingredients for Bread Dough

All-purpose wheat flour (type 55) variety "Malika" obtained from " Modern mill of Ivory Coast " (Figure 1) was used without any chemical or proteins supplementation. It was stored in a freezer at -20°C and then at 4°C for 1 to 3 days before using. Soumbara powder obtained from " Rama cereal of Ivory Coast " (Figure 2) was used at the proportions of 1%, 2%, 3%; 4% and 5% relative to the mass of the wheat flour. Basic dough formula (flour basis) consisted of 2 kg wheat flour (type 55), 30 g of salt, 1220g of ice water, 20 g of yeast, and 10 g of chemical improver.

2.2 Biochemical characteristics of dough bread

Protein, water and ash of the substitution flour 0f wheat flour and Soumbara powder were determined with AACC, 2000 method using Inframatic (infraneo chopin) analyzer. Alpha-amylase activity was determined with the Hagberg falling numbers instrument (Partens model no 1500, USA), of AACC, 2000 approved method. The Chopin alveograph was used to measure the bread dough Tenacity (P), extensibility (L), elasticity (P / L), swelling (G), baking strength (W) and elasticity index (Ie).

2.3 Bread loaves production

Bread loaves were produced according to AACC (2010) in the laboratory of the small-scale industrial bakery of the Modern mill of Ivory Coast. Spiral kneader with a capacity of 10 kilograms was used to knead the dough for 4 and 6 minutes respectively. The dough was then fermented (proofed) at 28°C during 2h. Baking was done in an oven at 235°C for 18 min. The samples bread were cooled for 2 h before to be used.

Figure 1 : Wheat Flour

Figure 2 : Soumbara Powder

2.4 Bread volume

The volume of the bread was measured by the millet seed displacement of AACC, 2010 method. The final bread volume (V) is then calculated using the following formula:

$$\text{Volume } (cm^3) = \frac{\text{Mass of grains collected}}{2.36}$$

2.36 = seed density

2.5 Bread Crumb and Crust Physical Properties

The bread crust and crumb were directly observed visually considering the colour, touch feeling, crust thickness and crumb alveoli width and number. Samples bread was cut in the parallel direction of it's lifting into the oven during the baking process in order to preserve and protect their alveolar structure. Samples breads, 3 mm of thickness were then scanned and used to the visual observation.

2.6 Biochemical analysis

Sample bread lipid, protein, carbohydrate and ash were determined using the method of AOAC (1995). Total Carbohydrate was obtained using this formula:

Total Carbohydrate = 100 – (% of lipid ± protein ± ash ± water).

Energy value was calculated using Atwater specific coefficients for protein, lipid and carbohydrate (FAO, 2006).

2.7 Sensory analysis

A sensory study was performed on bread samples according to the hedonic test taking into account general characteristics of bread such as texture, smell and taste of its crust and crumb. Intensity measurements of sample breads were done at six (06) levels, according to the method of AFNOR, 1995. This test was based on a panel of 17 tasters.

2.8 Statistical analysis

All determinations reported in this study were carried out in triplicates. Mean value and standard deviation were calculated. Analysis of variance (ANOVA) and correlations were also performed. Tukey's Honest Significant Difference (HSD) test at $P < 0.05$ was used for mean values separation. It was made in order to evaluate differences among samples while the relationship between measured parameters was assessed by Pearson's test (significant level at $p \leq 0.05$).

3. Results and discussion

3.1 Results

Some biochemical characteristics of dough bread

The table 1 shows some biochemical characteristics of different dough flours as function of different proportion of the Soumbara. The quantity of protein, ash and water of the flour were determined with an analyzer inframatic (Infraneo Chopin, LAB EQ020). The values of protein increase when the quantity of Soumbara increases from 11.7%±0.05 to 13.1%±0.98. The quantity of water decreases when the level of Soumbara increases from 13.9%±0.03 for the WS0 flour to 13.3%±0.23 for the WS5 flour. The Hagberg falling number of flours decrease from 342s for WS1 flour to 290s for the WS5 flour (Table 2).

Table 1: Some biochemical characteristics of doughs flours

	WS0	WS1	WS2	WS3	WS4	WS5
hagberg index (s)	342±2.29^{c}	350±3.98^{c}	316±1.82^{b}	314±1.90^{a}	313±2.85^{ab}	290 ±1.33^{a}
Protein (%)	11.7±0.05^{a}	12.1±0.02^{ab}	12.3±0.03^{ab}	12.5±0.20^{bc}	12.7±0.23^{c}	13.1±0.98^{d}
Water (%)	13.9±0.03^{c}	13.9±0.50^{ab}	13.8±0.70^{b}	13.7±0.65^{d}	13.6±0.03^{a}	13.3±0.23^{c}
Ash (%)	0.66±0.01^{a}	0.79±0.01^{b}	0.96±0.03^{c}	1.16±0.00^{d}	1.24±0.00^{e}	1.48±0.00^{f}

WS0: Wheat flour; WS1: Wheat flour and 1% of Soumbara ; WS2: Wheat flour and 2% of Soumbara ; WS3: Wheat flour and 3% of Soumbara ; WS4: Wheat flour and 4% of Soumbara ; WS5: Wheat flour and 5% of Soumbara; The parameters a,b,c,d,e and f are used to specify statistic values difference.

The table 2 shows some rheological characteristics of the different sample flours. The baking strength of the sample flours decreases when the quantity of Soumbara increase. The smallest value is 87 10-4 ± 0.23 for the flour WS5 containing the large amount of Soumbara. However, the control flour (WS0) has the highest tenacity values of 93 mm H_2O ± 0.77 than the different flours containing different proportion of Soumbara. The plasticity values of those sample flours varied between 1.22±0.02 and 0.72±0.08 and their extensibility did not follow a precise order values versus the proportion of added Soumbara (Table 2).

Table 2: Some rheological characteristics of flours

	WS0	WS1	WS2	WS3	WS4	WS5
P (mmH2O)	93±0.77^{a}	76±0.10^{ab}	71±0.35^{ab}	59±0.07^{c}	55±0.52^{ab}	50±0.19^{ab}
L (mm)	76±2.29^{a}	87±0.03^{c}	75±0.20^{bc}	81±1.86^{b}	72±0.23^{a}	69±0.03^{bc}
G	19.4±0.05^{a}	20.8±0.52^{ab}	19.3±0.10^{ab}	20±0.11^{a}	18.9±0.65^{d}	18.5±0.23^{a}
W (10^{e-4}J)	262±0.11^{a}	215±2.85^{ab}	169±0.20^{bc}	136±1.33^{a}	109±0.20^{bc}	87±0.23^{c}
P/L	1.22±0.02^{ab}	0.87±0.04^{ab}	0.95±0.00^{e}	0.73±0.04^{ab}	0.76±1.90^{c}	0.72±0.08^{a}
Ie (%)	59±1.33^{a}	52.3±0.08^{a}	46.3±0.03^{ab}	41.6±0.64^{ab}	35.8±0.64^{c}	30±0.59^{ab}

P: Tenacity; L: Extensibility; P / L: Elasticity; G: Swelling; W: Bakery force; Ie: Elasticity index. The parameters a,b,c,d and e are used to specify statistic values difference.

Breads Volume

The table 3 shows the volume of different breads. Breads volume decreased when the quantity of Soumbara increase from 1144.4±2,29 to 1432.20± 1,38 (Table 3).

Table 3: Breads Volume

Breads	Volume
PS0	1432.20±1.38^{a}
PS1	1398.30±2.88^{ab}
PS2	1389.83±3.91^{c}
PS3	1296.61±3.08^{d}
PS4	1237.28±1.95^{c}
PS5	1144.06±2.29^{bc}

PS0: Control bread; PS1: Bread with 1% of Soumbara; PS2: Bread with 2% of Soumbara; PS3: Bread with 3% of Soumbara ; PS4: Bread with 4% of Soumbara ; PS5: Bread with 5% of Soumbara. The parameters a,b,c and d are used to specify statistic values difference.

Bread Crumb and Crust Physical Properties

Figure 3,4,5,6, 7, 8 and 9 show breads, slices crumbs alveolar and crusts thickness of samples breads with different proportion of Soumbara. The crumbs of breads PS0, PS1, PS2 and PS3 have more alveoli with larger and rounded diameters than the control bread. Their crumb are white color and the crust are slightly darkened than the control bread. In contrast, the crumbs and crusts of the breads PS4 and PS5 have enough alveoli but smaller and more darkened than the other breads.

Figure 3: Different breads versus quantity of Soumbara

Figure 4: PS0 Crumb

Figure 5 : PS1 Cramb

Figure 6: PS2 Crumb

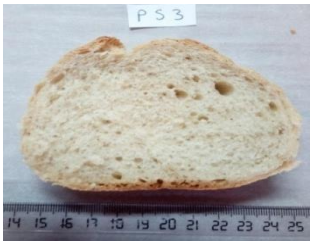

Figure 7: PS3 Crumb

Figure 8: PS4 Cramb

Figure 9: PS5 Cramb

Table 4 shows some Biochemical characteristics of sample breads. The quantity of water decrease when the Soumbara level increase. However, the quantity of basic dry flour increases from 64.49±0.03 to 68.80±0.23% (From PS0 to PS5). The protein, carbohydrate and ash levels increase with the increasing of the breads basic dry flour. The small quantities obtained are respectively 6.58 ± 0.05%; 55.31 ± 0.11% and 2.34 ± 0.01% for their PS0 and the large quantities are respectively 9.23 ± 0.98%; 55.74 ± 1.86% and 2.68 ± 0.00% for their PS5. The highest energy value was 270.27 ± 2.29 Kcal for PS5 while the lowest value was 249.93 ± 1.33 Kcal for PS0 than the control bread.

Table IV: Some biochemical composition of the bread

	PS0	PS1	PS2	PS3	PS4	PS5
Water (%)	35.51±0.03^{c}	34.72±0.64^{ab}	34.22±0.77^{b}	32.73±0.65^{d}	31.55±0.07^{a}	31.20±0.23^{a}
Basic Dry flour (%)	64.49±0.03^{a}	65.28±0.64^{ab}	65.78±0.77^{b}	67.27±0.65^{d}	68.45±0.07^{c}	68.80±0.23^{c}
Lipid (%)	0.26±0.08^{a}	0.44±0.04^{ab}	0.54±0.19^{ab}	0.60±0.10^{ab}	0.81±0.03^{bc}	1.15±0.64^{c}
Protéin (%)	6.58±0.05^{a}	7.07±0.02^{ab}	7.17±0.03^{ab}	7.70±0.20^{bc}	8.14±0.23^{c}	9.23±0.98^{d}
Carbohydrate (%)	55.31±0.11^{a}	55.40±0.59^{ab}	55.66±0.52^{ab}	56.49±0.35^{ab}	56.98±0.18^{ab}	55.74±1.86^{b}
Ash (%)	2.34±0.01^{a}	2.37±0.01^{b}	2.40±0.03^{c}	2.48±0.00^{d}	2.52±0.00^{e}	2.68±0.00^{f}
Energy (Kcal)	249.93±1.33^{a}	253.85±2.85^{ab}	256.23±3.91^{b}	262.18±3.08^{d}	267.77±1.90^{c}	270.27±2.29^{c}

The pameters a,b,c,d,e and f are used to specify statistic values difference.

Sensory analysis

Figure 10 shows the taste, smell, texture, color of the samples breads crust and crumb. These sensory characteristics were different appreciated by the tasters for each samples bread. These differences of sensory characteristics derived from the aftertaste and color of the crumb. PS5 is the one with the most aftertaste than the PS0. However, the white coloring of the PS0 crumb is the one that was most appreciated by tasters than that of the PS5.

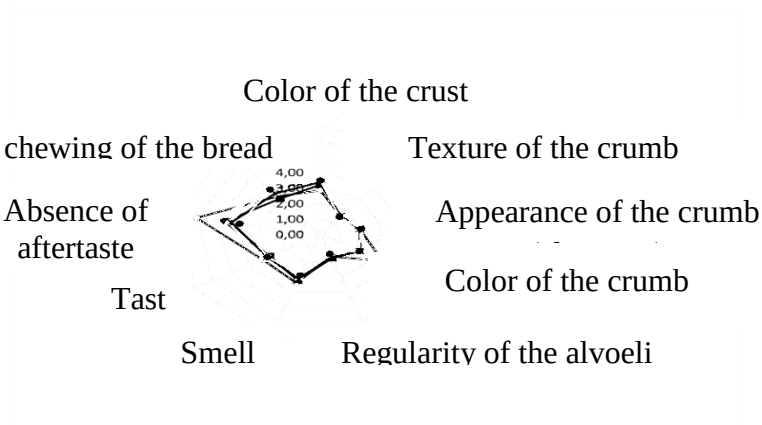

Figure 10 : Sensory characteristics of bread

4. Discussion

The quantity of protein, ash, water, Hagberg falling index of the Soumbara and wheat substitution flour were determined and then they were used to show the ability of this flour to be used in breadmaking. The resulting flour water values are between 13.3%±0.23 and 13.9%±0.03. These values are below of the standard limit value of 16% required to ensure a good conservation of flour (Chene, 2001) and to be used in breadmaking. According to Feillet, 2000, the flour water level is a very important factor to maintain the quality of the flour during storage. It is involved in the calculi of the other ingredients values on a dry basis flour. It also permit to determine the quantity of water necessary to achieve technological tests requiring constant final water level. The hagberg falling number showed amylase activity between 290s ±1.33 and 350s350±3.98. These values are within the interval time of [250-400 s] suggested by Lachance (2004). However, these values are below of the maximum value of 400s testifying the good quality of the flour. The incorporation of Soumbara in the wheat flour has a positive aspect on the amylase activity because it reduces the value of this falling number in the final substitution flour. This suggested an optimal amylase activity, which will

contribute to produce less sticky dough, a correct crumb leading a production of good breads quality.. The P / L ratio varying between 0.72±0.08 and 1.22±0.02. These values substantially correspond to the requirements of a standard bread flour which values are between 0.7 and 1.2 (Borasio, 1997). According to Borasio, 1997, this shows thus flours that will be easy to shape during kneading. The swelling values of the flours are between 18.5±0.23 and 20.8±0.52. These values are in the range of 20 to 24 which is the interval standards values of French breadmakig swelling values (Guinet and Godon, 1994). According to Guinet and Godon, 1994, flours that the swelling values are less than 20, have a good retention capacity of carbon dioxide during fermentation. These results are confirmed by Sakr and Hajj, 2007. These authors completed that corrections should therefore be made to flours whose swelling values are less than 20, in order to have a better swelling value and thus allow good carbon dioxide retention capacity during fermentation. . The baking strength of a flour is measured through its work "W" which represents the strength of the dough deformation until it breaks.The control flour (PS0) has a strain work of $262x10^{-4}$ J±0.11 whereas the different flour containing Soumbara have strain work between $87x10^{-4}$ J±0.23 (PS5) and $215x10^{-4}$ J± 2.85 (PS1). These results show clearly that values of flours containing Soumbara are lower than the values of the control flour as well as of those of the strain work of the French standards breadmaking which are between [200 - 220] × 10^{-4} J (Guinet and Godon, 1994). This could be due to the reduction of the gluten network by Soumbara film and therefore leading to the decrease of the final dough consistency, tenacity, elasticity and extensibility.The volume of the breads decrease when the proportion of Soumbara increases.This result is probably due to the denaturation of gluten protein caused by the Soumbara. It cause thus a decrease of the carbon dioxide gas retention capacity by the yeast during the dough fermentation.. The measurement of the dough

developpment shows a rapid increasing of the sample dough volume when the quantity of Soumbara increase. Thus a long time to the bread dough shaping will cause a collapse of the dough when they are placed in the oven, and that it will influence the final bread volume. The use of a protein flour or the reducing of the proof time may help to improve the final volume of the bread products. Some formulations showed an increase of the intensity of the breads crust and crumb coloration to dark brown color. This coloration can probably due to the dark brown color of the Soumbara powder used for the doughs samples formulations. Salah (2016) obtained similar results by including canola protein into bread dough without gluten. According to Salah (2016) the brown color of the final bread crust and crumb observed could be justified by the dark brown color of the Soumbara powder. A high quantity of protein are obtained in the dough and then in the final bread than the control bread. This quantity of protein in the final bread is probably due to the higher quantity of the Soumbara proteins.According to Diawara and al. (2004) Soumbara is an important source of protein with a quantity of 30 to 40%. At the same way, the increasing quantity of lipid and ash in the final bread could be attributed to the high quantity of lipid and ash in the Soumbara. According to Camara and al. (2016), the Soumbara contains a quantity of 18.42% of lipid and 2.81% of These values justified to the important quantity of lipid and ash in the Soumbara. The quantity of total carbohydrates in the Soumbara bread is higher than that of the control bread. However, these results of the total carbohydrate quantity are contrary to those of Ouazib (2017). This author confirmed that the association of wheat flour and legume powder would reduce the quantity of the total carbohydrates in the final product because of the low quantity of carbohydrates from legumes. Soumbara breads increase the energy value of bread than the control bread. These Soumbara breads can be recommended for the alimentation of people requiring a high expenditure of energy. The sensory profile revealed some differences in the Soumbara bread taste compared to the control bread, probably due to the addition of Soumbara. The proportions of Soumbara used to add to wheat flour should be studied and discussed in perspective.

5. Conclusion

parkia biglobosa **(Soumbara) fermented seeds** from Côte d'Ivoire have a lot of potential in breadmaking. The results of this study showed that the use of ***parkia biglobosa*** **(Soumbara) fermented seeds** at the formulation of breadmaking increased the final bread technological, organoleptical and nutritional properties. However the increasing of parkia biglobosa (Soumbara) fermented seeds quantity in this formulation at breadmaking process make the final bread crust and crumb slightly dark coloring and a decrease of its volume without affecting the quality of the finished bread compared to the standard appearance of the bread use at Ivory Coast.

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