Original Research Article

Production Of Gowe Flour, A Traditional Fermented Food Produced From Corn In Benin

ABSTRACT

Gowé is a paste fermented gotten to basis of pre-germinated corn. It is generally consumed, after dilution, in water as drink by an important layer of our populations as well in farming environment that urban. However, the conditions of its production and its conservation remain them always traditional and very little to study. This survey consisted in following the physico-chemical changes during the fermentation of the paste, to finalize a technology of drying and to appreciate the nutritional features of gowé. The results descended of the physico-chemical analyses show that the pH, the dry matter and the proteins decrease during fermentation. After 12heures fermentation, the gotten dough indicates a pH of 3.9, an acidity of 13.31%, a rate of humidity of 67.15% and content on average in proteins of 9.18% bMS. Otherwise, the assessment of the nutritional features revealed that gowé is richer in magnesium that in calcium and in iron. Besides, the introduction of the drying system in the technology of production of gowé permitted to get a product as cookie with a pleasant aroma. It has a pH of 3.95 with a rate of humidity of 9.7%. The statistical analysis of variance (ANOVA) done with the software MINITAB 14 on the gotten data indicates that put to part the dry matter that there is not any significant difference in the doorstep of 5% ($p < 0,05$) between the dough fermented and the dried gowé. By this nutritional composition, this flour could play important role in terms of health and are recommended for people of any ages, including the most vulnerable population who are often undernourished (young childrens, pregnant women, seniors and poor persons).

Keywords: gowé, maize grains, fermentation, dough, drying, flour.

1. INTRODUCTION

Drying is the oldest operation of stabilization of products, practiced by man. Today, it is used in a wide variety of sectors. Thus, drying makes it possible to store and valorize production surpluses in order to market them in times of shortage [1]. The sale of dried products offers interesting income prospects for rural families [1]. Drying thus allows food to be preserved for a long time and to make great savings. Not only does it reduce post-harvest losses, but it also reduces transport costs and thus promotes marketing beyond national borders.

In Africa, fermented food products are particularly used as weaning products for small children [2]. Most of these fermented products are prepared from cereals [3].

In Benin, the traditional fermented paste made from sprouted cereals is gowé. It is consumed as a drink after dilution in water with or without ice, sugar and sometimes milk. It is therefore a traditional Beninese fermented drink made from sprouted and unsprouted cereals [4]. In Benin, it is the preferred drink of children, pregnant women, the sick and even the elderly [5], because it is an important source of energy thanks to its high carbohydrate content (83.5%) [6]. The evaluation of nutritional parameters indicates that gowé is a food rich in protein, vitamins and minerals (calcium, iron and especially

magnesium) [6 ; 7]. However, the study conducted by [7] in the Central Benin regions (Abomey, Bohicon and Covè) considered as regions with high gowé production revealed that the problem of gowé conservation is acute. Thus, the shelf life of gowé is about three (03) days in Abomey and Bohicon while it is on average seven (07) days in Covè where women producers have introduced a steam cooking system in the production technology [7]. Therefore, despite the effort to extend the shelf life developed by women producers, gowé can only last for one week. Considering all the above, an acceptable solution could be found by exploring other horizons. It is therefore necessary to look for other sources of preservation that can validly replace steaming in order to give gowé a more hygienic and convenient form for export and to increase the availability and regularity of products on the markets. Thus, the main objective of this study entitled "Production of the traditional dried "gowé" paste in Benin" is to evaluate the physico-chemical parameters of "gowé" in order to develop an adequate preservation process for this paste for the feeding of vulnerable people.

2. MATERIAL AND METHODS

2.1. Materials

The variety of maize used was the white maize (Zea mays L.) locally called Adjakouin or Nikkikouin (in Fon language) recognized and chosen for this purpose by the women producers of gowé. The batch of corn was purchased at the Bohicon market. Water from the Société Nationale des Eaux du Bénin (SONEB) was also used.
The Memmert brand oven (Beschickung-Loading Modell 100-800) was used for drying. The analysis equipment is made up of conventional equipment used in laboratories of physicochemical analysis of foodstuffs.

2.2. Methods

2.2.1. Experimentation

The experimentation focused on the production of gowé by drying and reconstitution of gowé flour.

2.2.1.1.Technological scheme

The production of gowé was done according to the technological diagram in Figure 1. Thus, 3Kg of maize grains are weighed, sorted and washed. 2 of the 3 Kg are soaked for 18 hours at room temperature (28-30°C) in 2 liters of tap water (W/V=1/1). Then, the soaked grains are drained and germinated for 36 hours in a basket on a well-washed polyethylene bag. The 2Kg of germinated corn grains are spread on an ordinary sieve (sassado in Fon local language) to be dried in the sun for 24 hours. These 2Kg of dried germinated corn are mixed with the 1Kg of non-germinated corn to be crushed in a disc mill. After milling, the flour is allowed to cool and 4.5 liters of tap water (W/V=1/1.5) is added to the flour to form a soft uncooked dough in a sealed plastic bucket, which is fermented for 12 hours. After fermentation, the resulting dough is spread out on aluminum trays to be dried in an oven at 60°C for 24 hours. After drying, gowé is ground in a disc mill to obtain dried gowé flour. Finally, 150g of this flour is bagged with a heat-sealing machine to be stored at room temperature (28-30°C).

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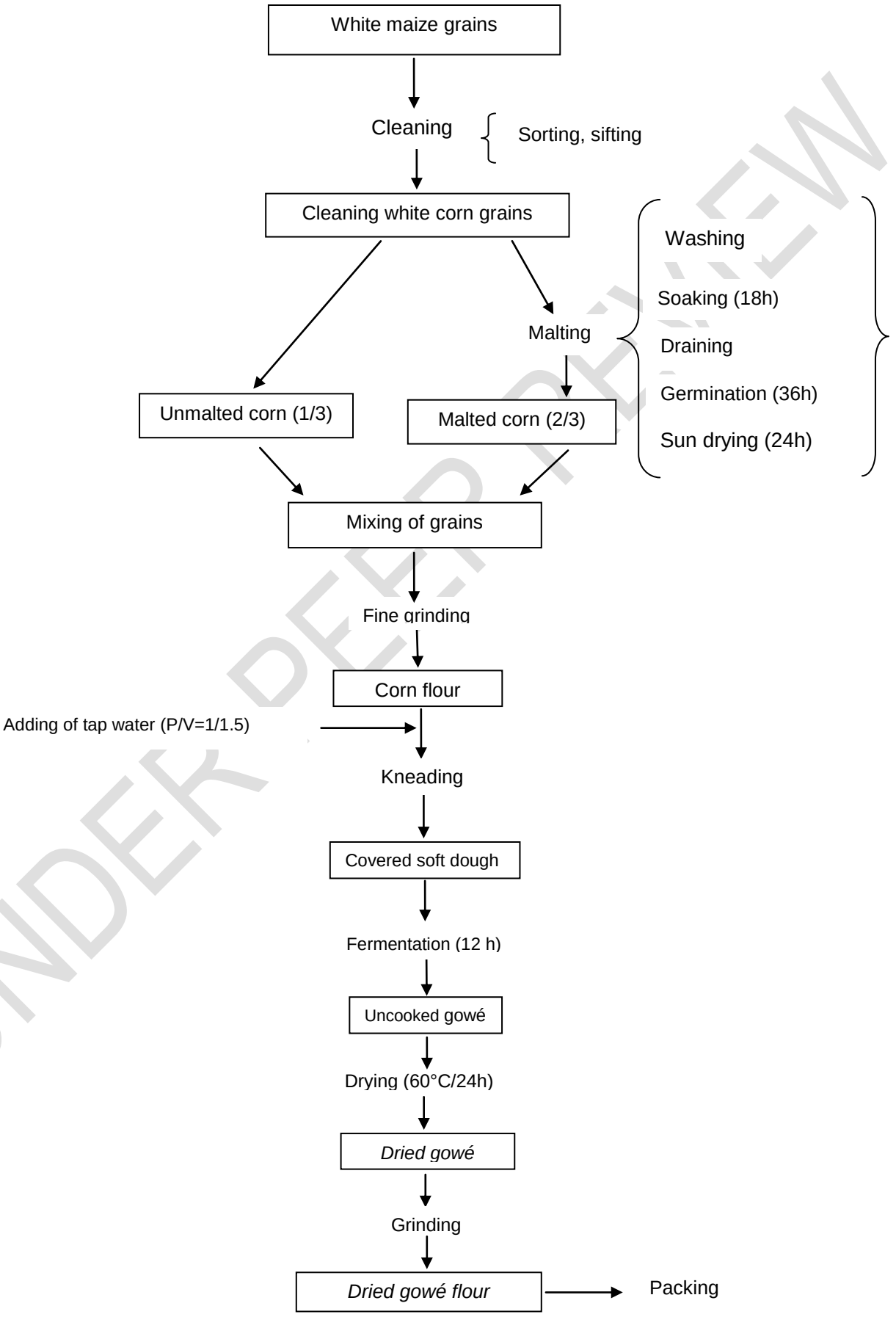

Figure 1 : *Production technology of dried gowé*

2.2.1.2. Method of reconstitution of dried gowé flour

The reconstitution of dried gowé flour is done in

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the following way :

- Empty 100g of dried gowé flour in 620ml of hot water (60°C),
- Stir to homogenize,
- Then let it cool and serve.

2.2.3. Physico-chemical analysis

The physicochemical analyses were done in order to know the pH, water, ash, crude protein, titratable acidity and microelements contents. Thus, the water content and the dry matter content were determined by AACC [8] from 5 g of product, by drying and differential weighing. The ash content was determined from the dry matter by calcination at 550 °C for 12 hours. Crude protein content (N x 6.25) was determined by the Kjeldahl micro method. The pH was measured using an electronic probe pH meter previously calibrated with buffer solutions of pH7 and pH4 at 28 °C. This measurement was taken on 25 mL of the sample. Titratable acidity was determined by the modified method of Nout *et al.* [9]. Microelements were determined by atomic absorption spectrophotometry. All analyses were repeated three times and the average of the values obtained was considered.

2.2.4. Statistical analysis of data

The data collected was entered and formatted using Word. Excel software was used to perform the calculations. MINITAB 14 software was used to analyze the results of physicochemical analyses ; the same software was used to perform the analyses of variance (ANOVA) for the comparison of means. The level of significance retained is 5% ($p<0.05$).

3. RESULTS AND DISCUSSION

3.1. RESULTS

3.1.1. Physico-chemical characteristics of maize grains

The corn grains used for production have a moisture content of 7.6% for non-germinated grains and 13.92% for germinated grains.

3.1.2. Physico-chemical changes during gowé fermentation

A significant decrease in pH was observed during fermentation ; it went from 5.4 at the beginning of fermentation to 3.9 at the end of fermentation. This resulted in an increase in acidity from 7.6% at the beginning to 13.31% at the end of fermentation (Figure 2). A decrease in dry matter and protein was also observed during fermentation (Figure 3).

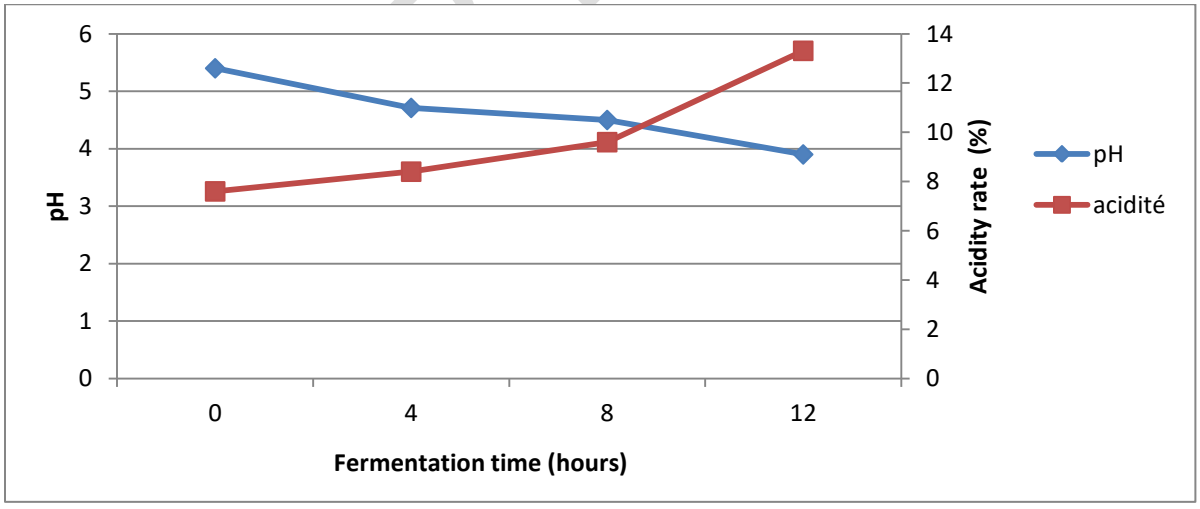

Figure 2 : Evolution of pH and acidity during gowé fermentation

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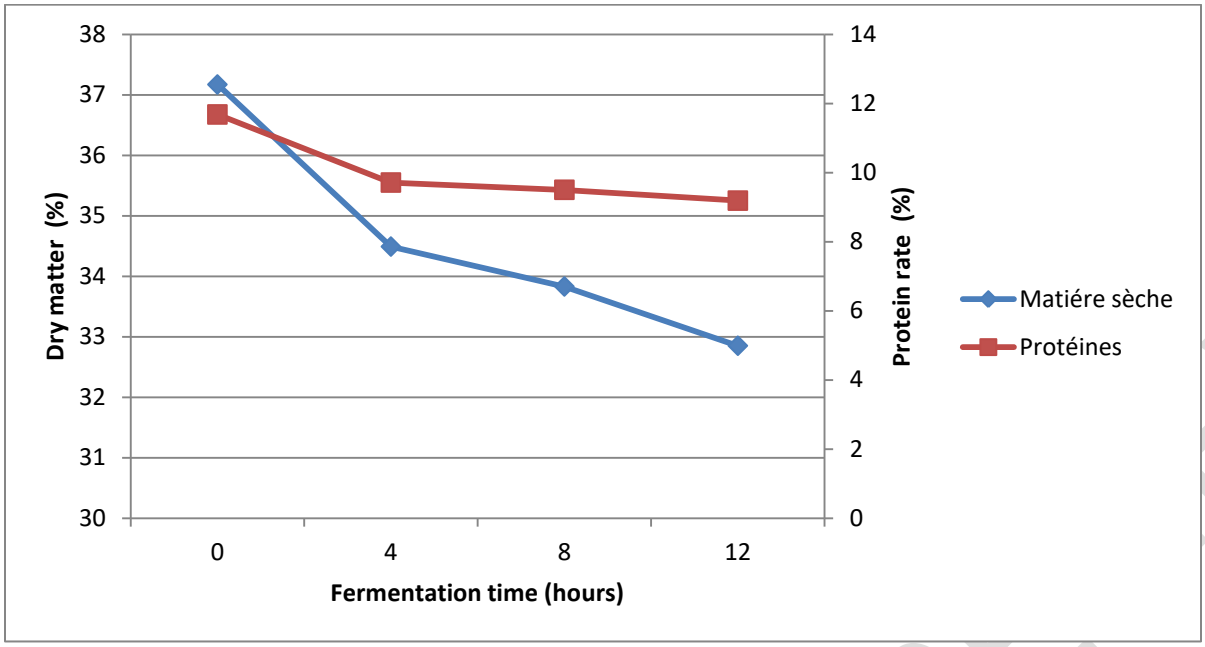

Figure 3 : Evolution of dry matter and protein content during gowé fermentation

3.1.3. Physico-chemical characteristics of gowé before and after drying

The results of the physico-chemical parameters of the dough fermented for 12 hours and of the dried gowé flour are given in Table 1.

Table 1 : Physicochemical characteristics of gowé before and after drying

Samples	pH	Titrable acidity %	Dry matter %	Ash % bMS	Proteins % Bms
Dough fermented (12 hours)	3.90±0.11[a]	13.31±3.71[a]	32.85±1.95[a]	1.00±0.10[a]	9.18±0.09[a]
Dry gowé flour	3.95±0.30[a]	13.21±1.02[a]	90.30±0.04[b]	1.02±0.15[a]	8.85±0.25[a]
P-value	0.812	0.968	0.000	0.860	0.164

Mean values with the same letter in the same column are not significantly different at the 5% level. Data represents in table is mean of three replications. ± Standard deviation.

3.1.4. Nutritional characteristics of gowé

Table 2 below shows the results of nutritional analysis of gowé. The analysis of the results shows that gowé contains more magnesium than iron and calcium.

Table 2. Nutritional characteristics of dough fermented (12 hours) and dried gowé flour

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Samples	Microelements (mg/100g ; bMS)		
	Ca	Fer	Mg
Fermented dough (12 hours)	36.11±4.84[a]	20.24±0.20[a]	76.55±22.2[a]
Dried gowé flour	32.25±2.5[a]	19.23±0.05[a]	73.72±21.4[a]
P-value	0.499	0.091	0.918

Mean values with the same letter in the same column are not significantly different at the 5% level. Data represents in table is mean of three replications. ± Standard deviation.

3.2. DISCUSSION

The results of physico-chemical analysis show that the water content (13.92%) of germinated maize grains used in production is in line with that (14%) obtained by Louembe *et al.* [10], while that (7.6%) of non-germinated grains is lower than that (13%) obtained by Tchekessi *et al.* [11]. The significant decrease in pH with a concomitant increase in titratable acidity over time of the gowé fermentation obtained (Figure 2) is similar to the results obtained by Banon et al. [12] and Vieira-Dalode [13]. Mugula et al. [14] said that the gradual decline of the pH and the increase of titratable acidity that are observed during fermentation are characteristic of flours of cereals in fermentation.The pH decreased to 3.9 at the end of the fermentation indicating that the medium becomes more acidic. This acidification is a major advantage from a hygienic point of view. It prevents the growth of most pathogenic germs and thus ensures the preservation of gowé. Nout *et al.* [9] and Tchekessi *et al.* [15] have shown that slurries at pH ≤ 4 made on a domestic scale by lactic fermentation have sufficient antimicrobial properties to limit contamination by microorganisms. As for the decrease in dry matter content (Figure 3), it is explained by the decomposition of the substrate and the production of water by lactic acid bacteria and yeasts during the metabolic reactions that took place during fermentation. Similarly, the decrease in protein content observed (Figure 3) is due to the action of microorganisms and biochemical reactions that develop during fermentation. This decrease in dry matter content during fermentation is similar to the results obtained by Vieira-Dalode [13]. Uncooked gowé has less dry matter (32.85%) than dried gowé (90.3%) (Table I) ; a difference that can be explained by a reduction of the water content by drying. The drying of the fermented dough resulted in a slightly sweet cookie product with a pleasant aroma. After grinding the dried gowé, the flour obtained is reconstitutable. The moisture content (9.7%) of this flour is close to the 11% obtained by Louembe *et al.* [16] on dried flour from fermented germinated maize dough. According to him, this moisture content close to the standard content (about 10%) of dried foods, can be considered as acceptable and preserves the dried dough from microbial contamination. Therefore, the moisture content of the dried gowé flour indicates that this flour can be stored for nine months if it is well packaged. Statistical analysis of the results of the nutritional parameters (Table II) shows that there is no significant difference at the 5% level between the iron, calcium and magnesium of the fermented dough and those of the dried gowé flour. Therefore, the drying technology developed avoids the massive destruction of the nutritional elements of gowé.

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4. CONCLUSION

The results of this work show that the fermented paste "uncooked gowé" has a high water content. The drying of this paste leads to a product of stable quality. The evaluation of nutritional parameters indicates that dried gowé contains protein, calcium, iron and is rich in magnesium. It is therefore recommended to children, pregnant women and elderly people to make up for the lack of microelements. After grinding dried gowé, the flour obtained can be reconstituted and kept for nine months.

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