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Production of tomato puree: an alternative to conservation of locally produced tomato in Benin

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Abstract

Tomato (*Lycopersicon esculentus*), is very cultivated solanaceous crop for its edible fruit, but very perishable (94,97% mc). After production, about 40% of tomato is lost due to lack of appropriate storage facilities. The aim of the present study is to suggest a mean of conservation of the surplus of production by processing tomato into puree. The most produced local variety of tomato "tounvié" in south Benin was used. The pulp was obtained using a refiner strainer /pulping machine and a milling machine. The concentration was achieved on gas cooker. Tomato purées of 12 - 15% of Total Soluble Solids (TSS) processed can be preserved for at least 12 months. The tomato purée showed absence of contamination of TPC, yeasts and moulds. This technology was introduced in real medium.

Key words: Lycopersicon esculentus, pulp, variety

Introduction

Tomato (*Lycopersicon esculentus*) is a very cultivated solanaceous crop that originated from Perou. It is very cultivated in different countries for its edible red fruit. The national production of Benin is closer to 140.000 tonnes; while south-Benin alone provides more than 70% of the total production (DPP/MDR, 2001). Seasonal production lasts three (3) to four (4) months. Losses from tomato's production amount to 40% when the total expenditure related to the imports of substitutes reaches in 1999 nearly 7,5 billion FCFA including 7,3 billion for tomato purees (Soulé, 2001). The price of a kilogram of tomato fruit varies between a minimum of 15 to 170FCFA and a maximum of 90 to 500FCFA. '' Tounvi' ' is the most cultivated variety (Faghohoun and Kiki, 2001). The only form of conservation was drying. However technological characteristics of this variety of tomato are closer to standard required for its processing into puree on industrial scale.

The main objective of this work is produce tomato puree of desirable quality and storable. Specific objectives were to determine the appropriate processing method of producing tomato puree to be a proposed to tomato processors in real medium, and the level of concentration (TSS) at which tomato puree could be preserved for at least one year.

Material and methods

The vegetative material used was the local tomato "tounvi". Table 1 shows that "tounvi" is more cultivated 62-63% and this justifies the choice of this variety for the tests, which focus on rural areas. This variety was acquired from producers in Ouidah (photo 1). The morphological characteristics and technological parameters are presented in table 2 and 3 respectively. The essential equipment used were stainless and aluminium utensils, recycled bottles, a gas cooker, an electric refiner strainer /pulping machine of 380 volts comprising of 2 sieves (1,5 and 0,8 mm), a milling machine ASIKO A11 VIKING 2,43 kw (3,31 PS).

Zone of study

Porto-Novo, administrative capital in the eastern part of Benin, department Ouémé-Plateau, at approximately 30km away from Cotonou was chosen. The city has a very big and important market for staple food; it is connected to Cotonou by a lagoon and is close to Nigeria.

The Laboratory of the Programme on Agricultural and Food Technology (PTAA) of the National Agricultural Research Institute of Benin (INRAB) was used for the processing of tomato into puree, but analyses were carried out at the Agronomic Faculty of Science of the University of Abomey-Calavi and at the Management of Food and Applied Nutrition (DANA).

Processing of tomato purée

The adopted processing technique was based on that recommended by Kyle *et al*. (1966): Processing operations like crushing and sifting are applied to some products such as apples, tomatoes, potatoes, etc. The sufficiently scalded product is mashed to puree by passing through a sieve, which retains the skins, the seeds, as well as the fibrous substances. It is necessary to evaporate the liquid contained in pulp by heating the product in a basin until the desired

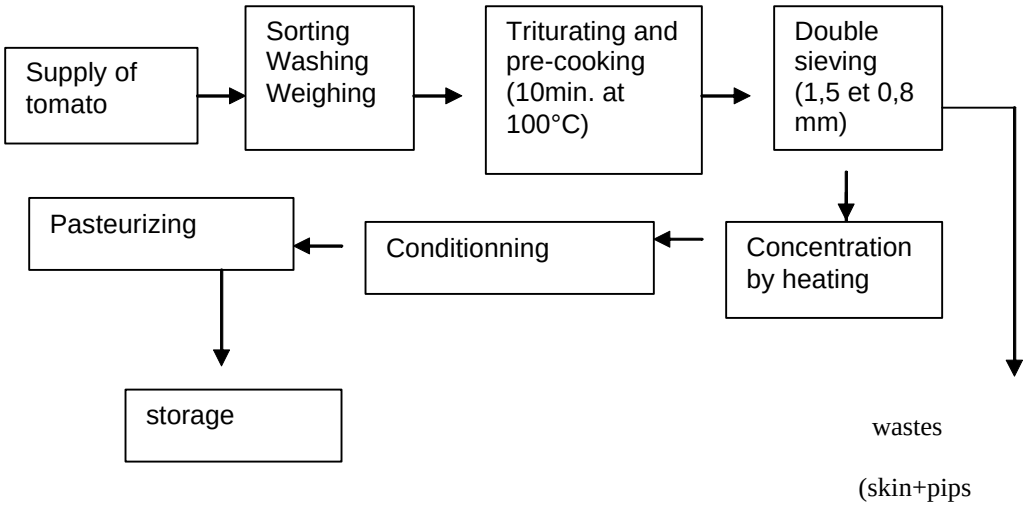

Figure 1. (Processing chart) : Pulp obtained using an electric refiner strainer /pulping machine

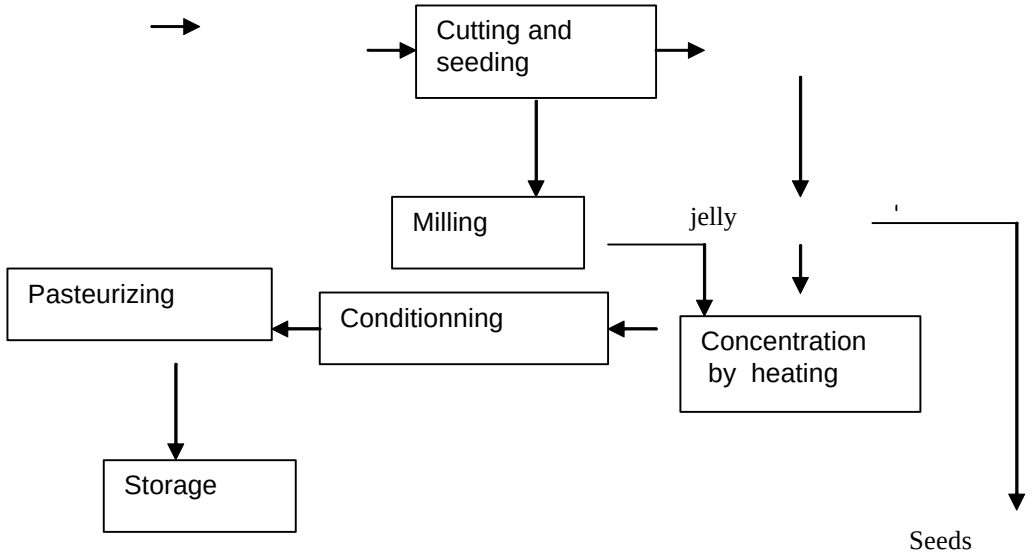

Figure 2. (Processing chart): Pulp obtained using seeding method and grinding at common maize milling machine

Table1: Production rate of local varieties of tomatoes in two zones of great production in South Benin

Varieties / Origin	Toundra	Ouaga	Kèkèfo	Akikon	Imported and assimilated varieties
Sèmè (%)	62	18	9	0	10,3
Aplahoué (%)	63	16	Rare	50% 1st season 0 after	9,8

Source : Fagbohoun O. et Kiki D. (2001) : 2001 sensus

Table 2: Morphological characteristics of the local variety of tomato «tounvi»

Variety	Origin	Shape Coefficient	Shape	Nombre de loges	Green collets	Colour	Average weight (g)	%seeds
Tounvi	Sèmè	0,73	Oblate and corded	2 à 4	Rare	Dark red	41,77	2,07
	Aplahoué	0,73			Rare		28,4	2,46

Source : Fagbohoun O. et Kiki D. (2001)

consistency is reach. Two methods were used to obtain the pulp, which is concentrated by gas with free air. The first method involved pre-heating of tomato for 10min., and pulping using the refiner strainer/pulping machine, while the second was to remove tomato seeds, and ground them manually after cutting. The product was thu ground using local milling machine. Grinding of product using common local milling machine aims at an extension of the technology because in Benin many rural area lack electricity and strainer/pulping machine cannot be acquired due to its high cost. The pulp obtained is filtered before concentration. Figure 1 and 2 indicate the processing charts for the two processes, repectively.

The cooking time varies between 2h and 2h35 min. During concentration of pulp, the Total Soluble Solids (TSS) is measured with the refractometer starting from10% thickening. Concentrated purees are filled into recycle bottles while hot and stabilized by a pasteurisation at 100°C during 20 min. Neither additive nor conservative was used. At the end of processing, tomato puree of 10, 12, 15 and 17% (TSS) were made and stored. During the period of storage, the purees were examined 15days after preparation, then every month. The microbiological analysis was made at each stage. Moisture content was determined by using the modified AACC method (1984). The pH is known by AOAC method (1984); direct reading with pH-meter. The hygienic quality control was made at DANA, main national body on quality control of foodstuffs in Benin

Results

Tables 3-5 give according to method 1, an average yield of 26,58% but method 2 gives a better percentage of 32,67%. At 12% of (TSS), tomato purees obtained using this method are the most consistent.

Tomato purée of 12% TSS can be stored for twelve months, but go beyond that; the determination of nutritional quality remains then capital. The failure of lids/covers (of recycled bottles) is detected within fifteen (15) days of follow-up; the rate of damage is lower than 2% (opening of lid, black stains on necks of bottles); fermentation is rare and relates to purees of 10-11% TSS, which presents supernatant on the surface. Puree exposed on the racks blacken on the surface then become completely black after six (6) months; in stock, damaged puree were also detected. Tomato purées subjected to the control of DANA (main national body on quality control of foodstuffs in Benin) were declared “acceptable and in conformity with the applicable standards and texts.

Discussion

In table 4 and 5, the percentage of wastes after seeding is high because of the residual juice. The average value 32,67% of the yield of purée when tomato seeds are removed manually is higher than that obtained when using the modern method (using strainer/pulping machine). This showed that manual processing of tomato into puree is recommendable for women processors on commercial scale when considering the yield.

Tomatoes were sorted and calculated from the initial primary weight during supply. The yield for this is not greater than 28,80%. The yield observed when making use of strainer/pulping machine is due to bad conditioning. Waste resulted from sorting reaches at times 28%. Women processors must take this into account while buying raw tomato. Fan Ungue *et al.* (1969) quoted by Fagbohoun relates the yield at TSS; therefore, to the quality of raw material. Cooking time of pulp from seeded tomato (manual process) is about 2 hours. Therefore milling of tomato with the skin could explain the higher consistency of puree for this method. Puree obtained are as well more consistent at the same percentage (%) TSS.

Table 6 shows the reduction of pH with a net increase in the acidity of puree. This negative correlation is normal; acidity of the medium lowers the pH. Olusanya (1984) noted the increase of acidity of tomato after drying. The pH<4,5 of purée encourages stability because it reduces the amount of micro organism that could be developed. Only acidophilus (yeast, mould, acetobacter and lactobacillus) can be developed. Dehydration index of 36ml is far from 96ml found by Soulé (2001) for imported concentrated tomato (28% TSS). But for this product being 100% pure puree of tomato is very doubtful.

The appearance of purée during storage does not vary and this denotes the adaptability of packaging material and the effectiveness of pasteurising. Discolouration of purees as observed is normal (coloured product). One could consider the hypothesis of oxidation caused by presence of vitamins C, A, E in tomato; Cheptel and Cheptel (1980) indicated that these oxidations in whatever way result into losses of colour and vitamin activities.

Table 3. Technological Parameters of « tounvi »

Origin	Variety	TSS	Sugar	Acid %	Is	Cs	Ca
Sèmè	Tounvi	5,1	3,1	0,5	6,4	61	9,4
Aplahoué		5,0	2,7	0,5	5,4	53	9,8

Source : Fagbohoun O. et Kiki D. (2001) ; Index of saccharose Is= $\frac{S}{A}$ x 100, Coefficient of saccharose Cs= $\frac{Sx100}{TSS}$, Coefficient of acidity Ca = $\frac{Ax100}{TSS}$ S= Sugar content ,A= Acid content of tomato and TSS= Total soluble solids

Table 4. Yield of purée using method1 (refiner strainer/pulping machine)

Tomato (kg)	Weight of pulp (kg)	Wastes (skin +seeds) (kg)	Puree (kg)	Yield %
15,27	11,88	1,83	4,15	27,17
15,27)	10,94	1,65	3,60	23,57
15,27	12,07	1,53	4,43	29,01
Average	11,63	1,67	4,06	26,58

Table 5. Yield of purée using method 2 (manual removal of tomato seeds)

Tomato (kg)	Emptied (kg)	Juice +seeds (kg)	Juice (kg)	Waste pips (kg)	Puree (kg)	Yield %
15,27	9,80	5,46	2,80	2,66	5,59	36,60
15,27	10,97	5,83	2,99	2,84	4,64	30,38
15,27	9,63	5,30	2,91	2,39	4,74	31,04
Ave rage	10,13	5,53	2,90	2,63	4,99	32,67

Table 6. Comparison of tomato and puree characteristics

Product	SS %	pH	Acidity %		Ash %	Rehydration index ml
			Malic	Citric		
Tomato	4,40	4,14	0,43	0,45	0,54	-
Puree	12	4,04	1,20	1,26	1,31	33

One can as well think of the reaction of Maillard. Substrates like ascorbic acid contained in tomato (0,23% according to Obi, 1986) are one of some compound carrying carbonyl functions contributing to the reaction of non-enzymatic browning during processing or storage of foods.

Conclusion

Production of tomato Purée constitutes a genuine alternative for utilising the loss of surplus tomato. Tomato processed into puree of 12% TSS can be stored for at least six month without alteration. The manual processing method, which can be used by processors in real medium, is recommendable on commercial scale. However, removing tomato seeds manually is time consuming. Although, the material used for packaging /conditioning tomato purees is acceptable a search for more adequate materials is already in progress.

Acknowledgment

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