Formulation of a juice cocktail based on pineapple, mango and carrots and studies of physicochemical, biochemical and microbiological parameters

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Abstract— **We used seven different formulations for the juice cocktail made from pineapple, mango and carrot. The pH varies from 4.4 to 4.5; titratable acidities range from 0.17 to 0.42; the ash rate varies from 0.19 to 0.38. We observe a low value of fat about 0.09% ± 0.05. Total sugars range from 6.10 to 28.1 °Brix; Vitamins C are present in all our formulations at concentrations ranging from 17.7 to 31.5 but also the presence of vitamins A, B2, D and E. Calcium and magnesium are present with respective concentrations of 7.22 and 3.90 mg / 100 ml. Brass and manganese are also present at 0.58 and 0.12 mg / mL respectively. The protein content varies from 0.33 to 1.03% and the glucose content varies from 10.03 to 16.90%. Note also the presence of fructose in our formulations. Regarding the microbiological parameters, we obtained results meeting the limits set by the ISO 4833 standard which governs the microbiology of the food chain.**

Index Terms— **formulation, cocktail, fruit, minerals, vitamins, ashes**

I. INTRODUCTION

Fruits and vegetables are a group of plant foods with better gastronomic properties [1]. From the botanical point of view, fruits are part of the plant which, at the stage of maturity, contain for the most part seeds [2]. They differ from vegetables in their high sugar content, relatively high acidity, pronounced aroma and raw consumption [1]. And vegetables are themselves defined as being all kinds of vegetable, herbs, root, edible seeds.

Abundant consumption of fruits and vegetables avoids most typing of cancer that affect humans. They are therefore the most effective anticarcinogenic foods, their richness in provitamin A, vitamin C and photochemical elements having an antioxidant action explains their anticarcinogenic effect [3].

The formulation of a juice cocktail based on fruits and vegetables (pineapple, mango and carrots) will allow the Congolese population, particularly African and in general to benefit from the health effect of its products. This formulation will help combat malnutrition and generate benefits for both producers and economic operators.

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PHYSICOCHEMICAL AND BIOCHEMICAL ANALYZES OF MANGOES

The microbiological and sensory analyzes were carried out in the microbiology laboratory of the Faculty of Sciences of the University of Kinshasa (UNIKIN) while the biochemical and physicochemical analyzes in the agrofood laboratory of the Congolese Office of Control (OCC), whose headquarters and administrative offices are located on Avenida del Port 98 in the municipality of Gombe and the laboratory department is located exactly on Kabasele Avenue.

The plant material used for the formulation of our fruit juice cocktail consisted of pineapples (Ananas comosus), mangoes (Mangifera indica) and carrots (Daucus carota subsp. of Kinshasa on September 18, 2018.

The water content is determined by stoving at 105 ° C for 24 hours [4]. The pH of our fresh and dried mango samples is obtained using the pH meter. Total ash is determined by calcination in a muffle furnace at 600 ° C for 24 hours [5]. The determination of the fat is obtained by Soxhlet extraction using petroleum ether. The density is obtained with a densimeter. Total sugars are determined by a Abbé refractometer [6]. Titratable acidity is determined by a titrimetric assay using phenolphthalein as an indicator. Vitamin C is determined by titrimetry, proteins by the Kjeldahl method [7]. Vitamins A, B2, D and E are identified by spectrometry. The mineral elements are determined by complexometry and atomic absorption spectrometry (AAS).

MICROBIOLOGICAL ANALYZES

The mesophilic, osmophilic and fungal germs are respectively determined using PCA medium (flat count agar), PCA osm and Sabouraud chl. Salmonella is identified using Selenite media.

SENSORY ANALYSIS

Dried mango slices were submitted to the assessment of 21 chemists in accordance with a sheet on which are inscribed the following annotations: smell, taste and color.

STATISTICAL ANALYSIS

Variance analysis was used using the Origin 8.1 pro [5] software.

II. RESULT AND DISCUSSION

Table 1 gives us the values of the physicochemical parameters of our seven formulations.

Table 1. Biochemical and physicochemical results

Parameters	Samples						
	F1	F2	F3	F4	F5	F6	F7
pH	4,52±0,01	4,55 ± 0,01	4,35 ± 0,01	4,35 ± 0,01	4,25 ± 0,01	4,27 ± 0,01	4,39 ± 0,01
Titratable acidity (g/L)	0,36± 0,03	0,29 ± 0,04	0,42 ± 0,02	0,31 ± 0,02	0,34 ± 0,02	0,27± 0,01	0,17 ± 0,02
Water content (%)	86,30± 0, 35	72,57 ± 0,08	83,64 ± 0,06	69,09 ± 0,11	86,61 ± 0,09	93,80 ± 0,09	89,47 ± 0,24
Ashes (%)	0,38 ± 0,03	0,37 ± 0,01	0,34 ± 0,01	0,29 ± 0,05	0,26 ± 0,04	0,19 ± 0,01	0,29 ± 0,06
Density	1,003 ± 0,002	1,054 ± 0,001	1,026 ± 0,002	1,029 ± 0,001	1,093 ± 0,001	1,067 ± 0,001	1,043 ± 0,001
Total sugars (°B)	12,70±0,02	25,00 ± 0,04	15,00 ± 0,02	28,10 ± 0,05	12,80 ± 0,03	6,10 ± 0,04	9,70 ± 0,04
Proteins (%)	0,93% ± 0,15	0,60% ± 0,05	0,60% ± 0,03	0,33% ± 0,07	0,98% ± 0,11	1,03% ± 0,09	1,34% ± 0,05
Fat (%)	0,12% ± 0,07	0,09% ± 0,05	0,08% ± 0,05	0,11% ± 0,06	0,09% ± 0,04	0,09% ± 0,04	0,12% ± 0,04
Glucose (%)	15,79% ± 0,36	16,90 % ± 0,14	15,83 % ± 0,74	16,31 % ± 0,57	12,28 % ± 1,07	11,22 % ± 1,66	10,03 % ± 0,31
Fructose	+	+	+	+	+	+	+

Legend: F1 = 35 :35 :30, F3 = 30 :10 :60, F5 = 20 :0 :80, F7 = 0 :10 :90. (Pineapple juice / carrot nectar / mange juice). F2=80% F1 :20% Sugar Syrup, F4=80%F3 :20% Sugar Syrup, F6=40% F5: 60% Potable Water.

Tableau 2. Concentrations of mineral elements of our formulations

Calcium (mg/mL)	6,70 ± 0,98	8,89 ± 1,45	6,72 ± 0,29	7,22 ± 0,21	6,41 ± 0,04	8,79 ± 0,31	5,49 ± 0,03
Magnesium (mg/100 mL)	5,25 ± 1,14	4,12 ± 2,11	4,22 ± 0,24	3,86 ± 0,36	3,90 ± 0,04	5,85 ± 0,95	3,81 ± 0,35
Copper (mg/mL)	0,39 ± 0, 05	0,67 ± 0,04	0,41 ± 0,08	0,58 ± 0,06	0,41 ± 0,03	0,47 ± 0,04	0,37 ± 0,04
Manganese (mg/mL)	0,10 ± 0,02	0,16 ± 0,02	0,13 ± 0,01	0,15 ± 0,04	0,12 ± 0,02	0,13 ± 0,06	0,12 ± 0,03

Table 3. Determination of vitamin C and identification of vitamins A, B2, D and E

Vitamin C	18,41 ± 0,38	17,66 ± 0,43	25,38 ± 0,55	22,14 ± 0,09	31,47 ± 0,66	17,64 ± 0,38	27, 39 ± 0,92
Vitamins A, B2, D and E	+	+	+	+	+	+	+

In the light of this table, we find that the water content of our samples is high, the values are between 69.09 and 93.80. This is justified by the fact that these juice nectars came from fleshy fruits [9]. The F6 sample is made up of drinking water, from which its high content is 93.80 ± 0.09%, while the F4 and F2 formulations have the lowest water content, ie 69.09 ± 0.11%. 72.57 ± 0.08% due to the presence of the syrup. These results, in light of the water content values that these products are rich in water and can actively contribute to the coverage of daily water requirements.

The raw ash values provide information on the mineral content of our samples with values ranging from 0.19 ± 0.01% to 0.38 ± 0.03%. We find that not all values have a significant difference, except for the F6 that has the lowest value in the series. This is explained by the dilution performed on the one hand and the geographical origin, climatic conditions on the other hand [10].

The density values for our formulations do not vary significantly, the values are between 1.003 ± 0.001 and 1.093 ± 0.002. These values are similar to that of orange juice 1,048 ± 0,001 found by Estève [11].

Regarding the total sugar content, the formulation F6 is again an exception with a value of 6.1 ± 0.01 lower than its counterparts, this is explained by the dilution carried out beforehand. Formulations F1, F3 and F5 have Brix values between 15.00 and 12.7 which are the consequence of the amount of pineapple juice and mango used. It should be noted that the total sugar content of pineapple juice was 17.53. This value decreased during formulation with orange to obtain a cocktail of fruit justifying the values in Table 1 [12]. As for the formulations F2 and F4 which have very high values in ° Brix respectively of 25.00 ± 0.04 and 28.10 ± 0.05 this is explained by the addition of 20% of the sugar syrup.

The pH values of our formulations vary from 4.25 ± 0.01 to 4.55 ± 0.01, our values are slightly lower than other fruit juices such as pineapple pH 3.97 ± 0.05 [13]; grapefruit pH 3.67 ± 0.01 [14] and orange with a pH of 3.52 ± 0.01 (12). This is justified by the dilution of our formulations. This acidity allows good storage of our products and stability at room temperature after pasteurization and storage [15]. Note that for some authors, a pH greater than 4 does not always guarantee a long-term preservation of juices [16].

We find that the titratable acidity of our formulations ranges from 0.17 ± 0.02 g / L to 0.42 ± 0.02 g / L. Compared to other fruit juices, they are lower. For example, grapefruit juice has an acidity of 0.94 ± 0.02 (g / L) [14], pomegranate juice 2.72 ± 0.03 (g / L) [17], the orange juice 7.8 ± 0.30 (13) and the lemon juice is 52.40 ± 2.50 (g / L) [15]. This can be justified by the fact that our fruits and vegetables have a low citric acid content and also that our formulations have been diluted.

Formulations with a higher titratable acidity content are those containing pineapple juice (F1, F3, and F5) while the less acidic ones contain a large amount of carrot juice. Note that the addition of sugar syrup decreases the titratable acidity content. All of our found values do not exceed the 0.5% limit as required by the AOAC standard [18].

We have identified vitamins A, B2, D and E and have measured vitamin C. Vitamins A and D come mainly from carrot juice and the rest of the vitamins come from the contribution of each of our fruits. Their presence reinforces the position of our formulations to combat malnutrition in our African fruit-producing regions.

Vitamin C (ascorbic acid) in addition to its physiological functions, has antioxidant properties that allow the body to fight against the accumulation of heavy metals such as lead, mercury and cadmium and reactive oxygen species. The vitamin C concentration ranges from 17.64 ± 0.38 mg to 31.47 ± 0.66 mg per 100 mL. By comparing the vitamin C content of our 7 formulations, we observe that the F3, F5 and F7 have high values because they contain a large amount of mango juice. The standard NF V 76-107 of natural fruit juices recommends that the concentration of vitamin C be between 200 and 500 mg / L, the majority of our formulations meet the standards with the exception of the formulation F1, F2 and F6.

The results show that the mineral content in our nectars varies according to the formulations. Calcium is the main mineral, its content varies from 5.49 ± 0.03 mg / 100 mL to 8.89 ± 1.45 mg / 100 mL, that in magnesium varies from 5.25 ± 1.14 to 3, 81 ± 0.35mg / 100ml, copper 0.67 ± 0.04 and 0.37 ± 0.04mg / 100ml and that in Manganese 0.16 ± 0.02 to 0.10 ± 0.02mg / 100mL. Some of our values are similar to that of the literature for mango nectar 5 mg / 100g calcium, 4.97 mg / 100g magnesium, 0.479g manganese and 0.02g copper [3]. Comparing our 7 formulations, we notice a slightly higher content in formulations F2, F4 and F6 this is justified by the addition of water or sugar syrup that can contain these measured minerals.

Glucose levels range from 10.03 ± 0.11% to 16.90 ± 0.14%. These values are low relative to the glucose content of pineapple juice (25% glucose) and carrot juice (20% glucose). A slight increase of about 1% is observed in the F2 and F4 formulations due to the addition of sugar syrup. Fructose has been identified and is present in all formulations. The protein content is between 1.34% ± 0.05 and 0.33% ± 0.07. These values are quite similar to those found by James [2] for pineapple juice 0.3g per 100g and some of our values are significantly higher than that found by ANSA [3] for mango juice (0.2g / 100g) carrot juice <0.5g / 100g. The addition of the sugar syrup slightly decreases the protein content and the formulations having a large amount of mango juice have a fairly high protein content.

Fruit and vegetable products are very low in fat, but they are found in very small quantities. It ranges from 0.12 ± 0.09% to 0.08 ± 0.05% in our samples. These values are found in the results of ANSA, which gives the lipid content in the juice and nectar of mango, carrot and pineapple (less than 0.2%).

MICROBIOLOGICAL ANALYSIS

Table 4 gives us the results of the microbiological analyzes (Enterobacteria, Salmonella, Yeasts, fungi and E. coli of our different formulations

Table 4. Results of microbiological analyzes of our formulations

Germes	F1	F2	F3	F4	F5	F6	F7
Entéro bactéries	3.10^2	5.10^2	3.10^2	5.10^2	3.10^2	$4 .10^2$	3.10^2
Salmonella	0	0	0	0	0	0	0
Yeasts and mushrooms	10^2	10^2	10^2	10^2	10^2	10^2	10^2
E Coli	0	0	0	0	0	0	0

In view of these microbiological results, we can say that according to the ISO 4833 standard that governs the microbiology of the food chain, our formulations are free from any contamination because no germ has been detected. This shows that the materials used were clean and the pasteurization was well done. These results meet the standard required by WHO for food products.

III. SENSORY ANALYSIS

Table 5 gives us the results of the sensory analyzes of our formulations by a panel of tasters

Table 5: Results of the sensory analyzes of our formulations

Formulations	Odor	Flavor	Coler	Dominant flavor
F1	French Mango	Sweet	Yellow orange	Mango
F2	French Mango	Very sweet	Yellow orange	Mango
F3	French Mango and fresh pineapple	Sweet	Yellow orange	Mango
F4	French Mango and fresh pineapple	Very sweet	Yellow	Mango
F5	French Mango	Sweet	Light yellow	Mango
F6	French Mango	slightly sweet	Yellow	Mango and pineapple
F7	French Mango	Sweet	Yellow	Mango

The table above gives us the results of the organoleptic analysis performed on our different juice formulations. A panel of 21 tasters composed of colleagues was set up for the assessments. The taste and the dominant flavor of our

products were that of mango this can be justified by the fact that the mango juice is very thick and viscous.

IV. CONCLUSION

We can benefit from all the health benefits offered by fruits and vegetables by the different formulations in the form of juice. we have highlighted the analytical composition of our formulations with a strong synergistic effect of the different products (pineapple, mango and carrots). Our formulations can be used to fight against malnutrition on the one hand and poverty on the other hand.

We observed that our products were rich in mineral elements which corroborates the ash content found. Our pasteurized products without chemical additives are holy, that is, free of microbiological contaminants

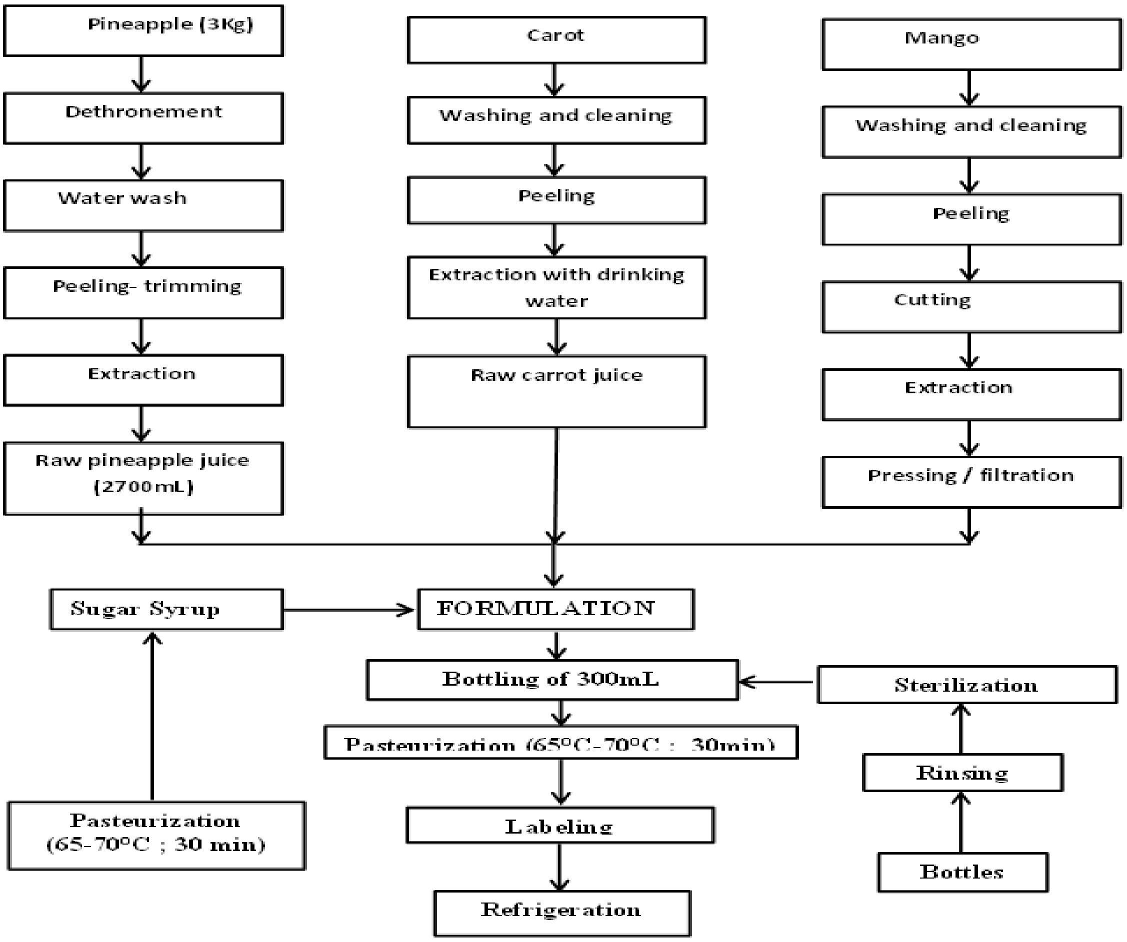

Figure 1. Diagram of the preparation of the juice cocktail.

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