Effect of bark of *Bridelia thermifolia* ("Kelle") on clarification of cashew apple juice

Djouka Nembot P. M[1*], Djafsia Synthia C.[2], Ponka Roger[2], Barbi Mathieu[1], Gnamtam Zenabou[1], Layla Hamadou[1], Satou Koulagna N.[1] and Njoya Moyouwou Amadou[3]

[1] Institute of Agricultural Research for Development (IRAD) - Food Technology and Post-harvest Laboratory, P. O. Box 415 Garoua, Cameroon

[2] Department of Agriculture, Livestock and Derivated Products, National Advanced School of Engineering of Maroua, University of Maroua, Cameroon

[3] Institute of Agricultural Research for Development (IRAD) - Bambui, B. P. 51 or 80 Bamenda, Cameroon

(*): Corresponding author; Email: pdjouka@yahoo.fr

Keywords: Bark of *Bridelia thermifolia* ("Kelle"); cashew apple juice; clarification; kinetic of clarification; sensory properties; physicochemical properties;

Submission 03/04/2023, Publication date 30/06/2023, http://m.elewa.org/Journals/about-japs

1. ABSTRACT

The objective was evaluation on the effect of clarification of cashew apple juice using bark of *B. thermifolia* locally called "Kelle". The crude cashew apple juice was produced using the red and yellow varieties and the yield of production was calculated. From each variety, 9 experimental samples were achieved by substituting the crude juice with "kelle" as clarifying agent from 1-9% in addition to the control sample (crude juice). The kinetics of clarification was determined with all the samples and their sensory properties (taste, astringency, colour and overall acceptability) were evaluated. From the sensory evaluation, the 3 more appreciated products were subjected to physicochemical analyses (pH, turbidity, titratable acidity, total sugars, vitamin C, total carotenoids, β-carotene, total polyphenols and total tannins). The result showed that yield of juice was not affected by the cashew apple variety. Samples with 1% of *B. thermifolia* ("Kelle") showed the greatest kinetic of clarification and control sample the lowest independently of the cashew apple variety. In general, "Kelle" improved the sensory properties of cashew apple juice and this achievement reduced with increasing of its concentration. The clarifying agent affected the physicochemical properties of the cashew apple juice. There was decrease of the total carotenoids, total polyphenols, β-carotene, total tannins, vitamin C and titratable acidity and, increase in the turbidity, pH and total sugars contents. Clarification of cashew apple juice with 1% of *B. thermifolia* or "Kelle" had the highest total carotenoids, β-carotene, vitamin C and best sensorial. It also had the lowest tannins and total polyphenols contents and hence, it should be recommended.

2. INTRODUCTION

The cashew tree (*Anacardium occidentale* L) is a tree that may grow to ten meters in height (Lautie *et al.*, 2001).Its sector contributes to the socio-economic development of many countries (De figueiredo *et al.*, 2001; Marlos *et al.*, 2007). However, in Cameroon, it is still not prominent and is farmed only in the Northern part of Cameroon, the Adamaoua, North and Far-North regions (Sali *et al*, 2020). According, to the document of the national strategy for promotion and development of cashew sector, 50 000 tons of production should be achieved in 2025. The cashew fruit is composed of the cashew nut and the cashew apple. Cashew nut is the main product and corresponds to the "real fruit". It is used in the food industry, cosmetic, medicine

and automobile industry (Lacroix, 2003; Aboh *et al.*, 2011; Soro, 2012). The cashew apple also called the "wrong fruit" is considered as by-product and has a high nutritive value. It is principally rich in carbohydrates, vitamin C (6 times more that of fresh orange fruit) and carotenoids (Assunção and Mercadante, 2003; Michodjehoun-Mestres *et al.*, 2009; Ouattara *et al.*, 2016). However, although having great nutritional benefits, processing of cashew apple into juice is still limited. In fact, it is because of high tannins content, responsible of the astringency and poor texture of the juice (Dossou, 2008; Soro, 2008). Various artisanal techniques of clarification such as utilisation of cashew gum, rice gruel, cassava liquefied starch and tangential microfiltration have been developed in order to improve on the quality of cashew apple juice (Houssou *et al.,* 2016; Zouffoun, 2017). Nevertheless, it is also important to develop techniques, which are simple and efficient using local material or resources. The use of bark of *Bridelia thermifolia* commonly called "Kelle" could then be beneficial. In addition, it is very available and has low cost. This may have positive impact on the cashew sector by improving the livelihood of its actors and the cashew apple juice processing. Therefore, the present study aims to investigate on the effect of clarification of cashew apple juice using bark of *B. thermifolia* ("Kelle").

3 MATERIAL AND METHODS

3.1. Biological material: The yellow and red varieties of cashew fruit were obtained from Bockle, Garoua III Sub-Division, Benoue Division and North Region of Cameroun. The dry bark of *B. thermifolia* was purchased at Garoua main market.

3.2. Production of crude cashew apple juice: After selection, the cashew fruits collected were cleaned and washed several time with potable water. The cashew apple ("wrong fruit") was then separated from the nut and soaked in water containing 100 ppm of active chlorine during 20 minutes. After, it was sliced and blended. The crude cashew apple juice was obtained by squeezing the paste previously acquired using a mousseline cloth. The yield of production of crude cashew apple juice was calculated using the following formula:

$Yield\ (\%) = V*100/W$

V: Volume of crude cashew apple juice obtained (l) W: Weight of Cashew apple (kg)

3.3 Production of B. thermifolia extract: The *B. thermifolia* extract was achieved by infusing the bark in water at 50 °C according to Saidou *et al.* (2012).

3.4 Production of clarified cashew apple juice: Clarification of cashew apple juice was done by substituting the crude juice with extract of red or yellow varieties of *B. thermifolia bark*. The mixture was then agitated and allowed to sediment at room temperature. Twenty (20) experimental samples were then prepared as indicated in tables 1 and 2 below while the crude juice served as control. The clarified juice was then collected and pasteurised at 80 °C for 05 minutes in hot water bath. After, it was cooled at room temperature in cold- water bath and kept in refrigerator prior to analyses.

Table 1: Cashew apple juice samples from the red variety

Samples	JRS0	JRS1	JRS2	JRS3	JRS4	JRS5	JRS6	JRS7	JRS8	JRS9	JRS10
Crude red cashew apple juice (ml)	500	495	490	485	480	475	470	465	460	455	450
B. thermifolia extract (ml)	0	5	10	15	20	25	30	35	40	45	50
Final volume (ml)	500	500	500	500	500	500	500	500	500	500	500
Substitution (%)	0	1	2	3	4	5	6	7	8	9	10

JRS0: Crude red cashew apple juice; JRS1: Red cashew apple juice substituted at 1%; JRS2 : Red cashew apple juice substituted at 2% ; JRS3: Red cashew apple juice substituted at 3% ; JRS4 Red cashew apple juice substituted at 4% ; JRS5 : Red cashew apple juice substituted at 5% ; JRS6 : Red cashew apple juice substituted at 6% ; JRS7: Red cashew apple juice substituted at 7% ; JRS8: Red cashew apple juice substituted at 8% ; JRS9: Red cashew apple juice substituted at 9%; JRS10: Red cashew apple juice substituted at à 10%

Table 2: Cashew apple juice samples from the yellow variety

Samples	JJS0	JJS1	JJS2	JJS3	JJS4	JJS5	JJS6	JJS7	JJS8	JJS9	JJS10
Crude Yellow cashew apple juice (ml)	500	495	490	485	480	475	470	465	460	455	450
B. thermifolia extract (ml)	0	5	10	15	20	25	30	35	40	45	50
Final volume (ml)	500	500	500	500	500	500	500	500	500	500	500
Substitution (%)	0	1	2	3	4	5	6	7	8	9	10

JJS0: Crude yellow cashew apple juice; JJS: Yellow cashew apple juice substituted at 1%; JJS2 : Yellow cashew apple juice substituted at 2% ; JJS3: Yellow cashew apple juice substituted at 3% ; JJS4 Yellow cashew apple juice substituted at 4% ; JJS5 : Yellow cashew apple juice substituted at 5% ; JJS6 : Yellow cashew apple juice substituted at 6% ; JJS7: Yellow cashew apple juice substituted at 7% ; JJS8: Yellow cashew apple juice substituted at 8% ; JJS9: Yellow cashew apple juice substituted at 9%; JJS10: Yellow cashew apple juice substituted at à 10%

3.5 Kinetic of clarification: The kinetic of clarification was determined with 10 ml of the mixture (crude cashew apple substituted by the bark extract of *B. thermifolia*). During sedimentation, the supernatant was collected at 5 minutes' intervals and the volume recorded until constant value. The kinetic was achieved by observing the variation of supernatant (clarified juice) volume (ml) with respect to the time (min).

3.6 Sensory evaluation: The sensory evaluation of the clarified juice samples was carried out using a 9-points hedonic scale with following as categories presented in table 3. Colour, astringency, taste and overall acceptability were evaluated by 30-trained panellists who were not presenting any negative response after cashew apple juice consumption. However, they were semi-naïve (not used) to the product.

Table 3: Sensory evaluation categories

Quality description	Extremely poor	Very poor	poor	Below fair	Fair	Above fair	Good	Very good	Extremely good
score	1	2	3	4	5	6	7	8	9

From the sensory evaluation, amongst the experimental samples and for each variety of cashew apple used, the best 03 in term of overall acceptability were selected and subjected to physicochemical analyses in addition to the control sample.

3.7 Physicochemical analyses: The physicochemical parameters of clarified cashew apple juice analysed were:

- pH by using 50 ml of juice according to AOAC (1995);
- Turbidity as prescribed by the norm ISO 7027-1 with a turbidity meter at 890 nm (1SO, 2016);
- Titratable acidity by titration in presence of sodium hydroxide 0.1 N with phenolphthalein as colour indicator (AOAC, 1995);
- Vitamin C content by dosage in presence of dichlorophenol indophenol (DCPIP);
- Total sugar content after extraction and dosage as indicated by Dubois *et al.* (1956);
- Tannins content according to Michodjehoun-Mestres (2009);
- Total phenols content according to the Folin-ciocalteu method as stipulated by Marigo (1973).

3.8. Data analysis: Data collected were presented as Means ± SD. They were subjected to analysis of variance (One-way ANOVA) using the statistica 7.1 statistical package. Means obtained were separated using the Student-Newman-Keuls test at 95% confidence level.

4 RESULTS AND DISCUSSION

4.1 Yield of production of crude cashew apple juice: The yield of production of crude cashew apple juice is presented in table 3. The yellow and the red varieties of cashew apple indicated similar yield of juice production ($p>0.05$). Thus, it appears that the yield of production of crude cashew apple juice is not affected by the variety used.

Table 3: Yield (%) of production of crude cashew apple juice

	Red variety	**Yellow variety**
Weight of cashew apple (Kg)	20	20
Volume of crude juice (l)	18^a	$17,7^a$
Yield (%)	90^a	$88,5^a$

(a,b): value with the same superscript letter in the same line are not significantly different ($p>0.05$)

4.2 Kinetic of cashew apple juice clarification: The figures 1 and 2 are presenting the kinetic of clarification of cashew apple juice with yellow and red varieties.

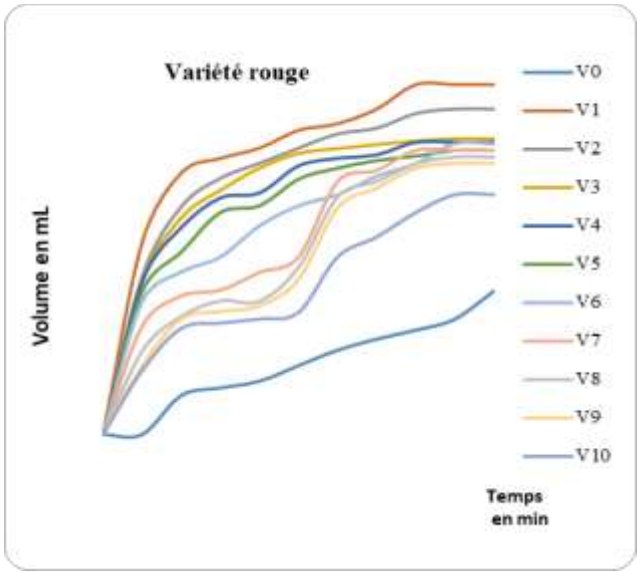

Figure 1: Kinetic of clarified juice from red cashew apple variety

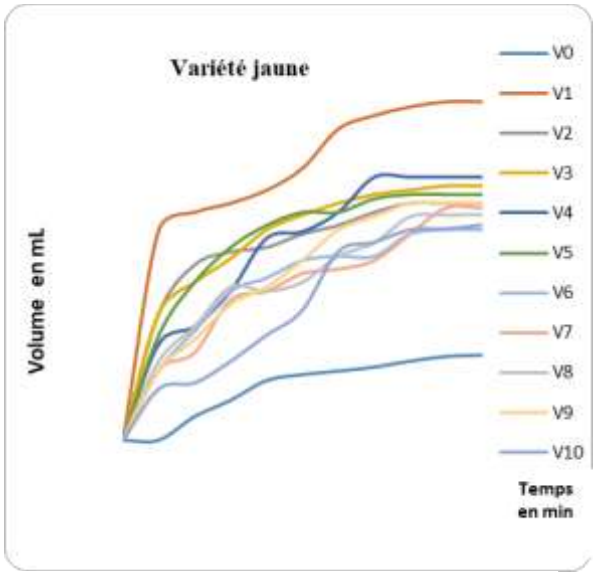

Figure 2: Kinetic of clarified juice from yellow cashew apple variety

V_0 : Variation of clarified juice (supernatant) volume at 0% of "kelle"; V_1 : Variation of clarified juice (supernatant) volume at 1% of "kelle" ; V_2 : Variation of clarified juice (supernatant) volume at 2% of "kelle" ; V_3 : Variation of clarified juice (supernatant) volume at 3% of "kelle"; V_4 : Variation of clarified juice (supernatant) volume at 4% of "kelle"; V_5 : Variation of clarified juice (supernatant) volume at 5% of "kelle"; V_6 : Variation of clarified juice (supernatant) volume at 6% of "kelle"; V_7 : Variation of clarified juice (supernatant) volume at 7% of "kelle"; V_8 : Variation of clarified juice (supernatant) volume at 8% of "kelle";; V_9 : Variation of clarified juice (supernatant) volume at 9% of "kelle"; V_{10} : Variation of clarified juice (supernatant) volume at 10% of "kelle";

From the figures 1 and 2, during the first period (5 min) of clarification, no supernatant was observed with control sample while that at 1% of *B. thermifolia* ("Kelle") had the highest volume of supernatant (red and yellow varieties indicated 5.4 and 5.8 ml of supernatant, respectively). This value seemed to be great amongst all the period with experimental samples. In general, the volume of clarified cashew apple juice of all the samples was increasing with duration until a constant value after 35 and 40 minutes respectively for red and yellow varieties. However, the sample having 1% of *B. thermifolia* revealed the best result during the clarification period and the control sample the lowest independently of the cashew apple variety.

4.3 Sensory evaluation: The results in table 4 are those of sensory evaluation of clarified cashew apple juice from red variety.

Table 4: Sensory evaluation scores of clarified cashew apple juice from red variety

Sample	Colour	Taste	Astringency	Overall acceptability
JRS0	5.30 ± 0.64^{ab}	2.06 ± 0.84^{a}	1.16 ± 1.12^{a}	2.16 ± 0.65^{a}
JRS1	7.58 ± 0.80^{c}	7.77 ± 1.05^{d}	8.06 ± 1.06^{d}	8.16 ± 0.66^{d}
JRS2	6.90 ± 0.88^{c}	7.08 ± 0.4^{cd}	7.11 ± 1.37^{cd}	7.60 ± 0.92^{c}
JRS3	6.36 ± 0.85^{bc}	6.53 ± 1.08^{c}	6.64 ± 1.14^{cd}	6.18 ± 0.84^{bc}
JRS4	4.43 ± 1.17^{a}	5.48 ± 1.15^{bc}	5.67 ± 1.02^{c}	5.22 ± 1.25^{b}
JRS5	5.93 ± 1.31^{b}	4.03 ± 1.03^{b}	4.23 ± 1.09^{bc}	4.43 ± 1.02^{bc}
JRS6	5.96 ± 1.47^{b}	3.95 ± 1.26^{b}	4.05 ± 1.01^{b}	4.06 ± 1.02^{bc}
JRS7	4.83 ± 2.08^{ab}	3.00 ± 0.73^{ab}	3.48 ± 1.50^{b}	3.80 ± 0.74^{b}
JRS8	4.29 ± 1.50^{a}	3.09 ± 1.44^{ab}	3.61 ± 1.54^{c}	3.29 ± 0.69^{b}
JRS9	4.06 ± 1.61^{a}	2.64 ± 0.70^{a}	2.38 ± 1.26^{ab}	2.80 ± 0.69^{ab}
JRS10	4.41 ± 1.58^{a}	2.09 ± 0.83^{a}	2.25 ± 1.22^{ab}	2.38 ± 0.98^{a}

(a,b,c,d): value with the same superscript letter in the same column are not significantly different (p>0.05). *JRS0: Crude red cashew apple juice; JRS1: Red cashew apple juice substituted at 1%; JRS2 : Red cashew apple juice substituted at 2% ; JRS3: Red cashew apple juice substituted at 3% ; JRS4 Red cashew apple juice substituted at 4% ; JRS5 : Red cashew apple juice substituted at 5% ; JRS6 : Red cashew apple juice substituted at 6% ; JRS7: Red cashew apple juice substituted at 7% ; JRS8: Red cashew apple juice substituted at 8% ; JRS9: Red cashew apple juice substituted at 9%; JRS10: Red cashew apple juice substituted at à 10%*

The lowest score was achieved with control sample (0% of "Kelle") in terms of astringency, taste and overall acceptability and, with sample having 9% of "Kelle" about colour. Red cashew apple juice clarified with 1% of *B. thermifolia* ("Kelle") indicated the highest score with all the parameters studied. Nevertheless, it was appreciated at the same level (p>0.05) with red cashew apple juice clarified at 2 and 3% of "Kelle" in terms of colour and astringency and, red cashew apple juice clarified at 2% concerning the taste. However, it was the best overall (p≤0.05). In general, there was a decrease of sensorial properties of clarified juice with increasing of clarifying agent concentration amongst experimental samples.

Table 5: Sensory evaluation scores of clarified cashew apple juice from yellow variety

Sample	Colour	Taste	Astringency	Overall acceptability
JJS0	3,30 ± 0,64^{a}	2,10 ± 0,73^{a}	2,32 ± 1,12^{a}	2,36 ± 0,51^{a}
JJS1	8,48 ± 0,60^{e}	8,75 ± 1,05^{e}	8,13 ± 1,6^{d}	8,86 ± 0,79^{d}
JJS2	7,09 ± 0,84^{cd}	7,013 ± 0,4^{de}	7,71 ± 1,33^{cd}	7,80 ± 0,2^{d}
JJS3	6,77 ± 0,85^{cd}	6,53 ± 1,08^{cd}	6,64 ± 1,14^{c}	6,81 ± 0,84^{cd}
JJS4	4,43 ± 1,17^{b}	4,48 ± 1,15^{c}	5,73 ± 1,02^{bc}	5,82 ± 1,55^{c}
JJS5	5,93 ± 1,31^{c}	4,03 ± 1,03^{c}	4,23 ± 1,09^{b}	4,43 ± 1,23^{bc}
JJS6	5,96 ± 1,47^{c}	3,95 ± 1,26^{bc}	4,05 ± 1,01^{b}	4,06 ± 1,02^{bc}
JJS7	4,33 ± 1,08^{b}	3,70 ± 0,72^{bc}	3,48 ± 1,50^{ab}	3,09 ± 0,54^{ab}
JJS8	4,29 ± 0,01^{b}	3,29 ± 1,04^{ab}	3,61 ± 1,54^{ab}	3,29 ± 0,69^{b}
JJS9	4,06 ± 1,61^{ab}	2,64 ± 0,70^{a}	2,69 ± 1,66^{a}	3,18 ± 0,19^{b}
JJS10	3,41 ± 1,58^{a}	2,66 ± 0,83^{a}	2,95 ± 1,22^{a}	3,06 ± 0,98^{ab}

(a,b,c,d): value with the same superscript letter in the same column are not significantly different (p>0.05). JJS0: Crude yellow cashew apple juice; JJS1: Yellow cashew apple juice substituted at 1%; JJS2 : Yellow cashew apple juice substituted at 2% ; JJS3: Yellow cashew apple juice substituted at 3% ; JJS4 Yellow cashew apple juice substituted at 4% ; JJS5 : Yellow cashew apple juice substituted at 5% ; JJS6 : Yellow cashew apple juice substituted at 6% ; JJS7: Yellow cashew apple juice substituted at 7% ; JJS8: Yellow cashew apple juice substituted at 8% ; JJS9: Yellow cashew apple juice substituted at 9%; JJS10: Yellow cashew apple juice substituted at à 10%

From the results in table 5, the control samples was the less appreciated with all the parameters evaluated. On the other hand, the yellow cashew apple juice clarified by addition of 1% of "Kelle" revealed the highest score across all the samples. Its colour was highly ($p \leq 0.05$) valued. However, it was comparative ($p > 0.05$) to clarified cashew apple juice from yellow variety with 2% of "Kelle" in term of astringency and taste and, clarified cashew apple juice from yellow variety with 2 and 3% of "Kelle" overall. Generally, sensory properties of the clarified juice from the yellow variety decreased with the increase of clarifying agent. The low appreciation of sensory properties of clarified juice with the increase of "kelle" could be as results of the level of polyphenols and tannins, present in *B. thermifolia*. Studies have showed that polyphenols and tannins are responsible of the astringency and poor texture of food product (Abreu *et al.*, 2005; Dossou, 2008; Soro, 2008; Adou *et al.*, 2012) which could also lead to negative response on its taste and implicitly on its acceptability.

4.4. Physicochemical properties of Cashew apple juice: The physicochemical properties of cashew apple juice from the most preferred are presented in table 6.

Table 6: Physicochemical properties of cashew apple juice

Samples	Turbidity (UNT)	Titratable acidity (mg of citric acid/100 ml)	pH	Vitamin C (mg/100 ml)	Total sugars (g /100 mL)	Total Carotenoids (mg/100 mL)	β-Carotene (µg/100 mL)	Total tannins (mg /100 mL)	Tota polyphe (mg /10
Cashew apple juice from red variety									
JRS0	37± 18 ^{c}	26.67 ± 0.01^{c}	5.15± 0,08 ^{b}	180.00 ± 0.01^{c}	3.51 ± 0.39^{a}	4.33 ± 0.32^{f}	105.10 ± 0.01^{b}	2.91 ± 0.37^{b}	5.48 ±
JRS1	12.01± 39 ^{a}	25.04 ± 3.85^{bc}	5.87± 0,9 ^{d}	177.22 ± 10.58 ^{bc}	5.56 ±0.27^{bc}	3.86 ±0.01^{e}	101±0.01^{b}	0^{a}	1.34±
JRS2	12.05±0,6 ^{a}	25.33 ±0.01^{b}	5.87± 0,19 c ^{d}	163.33 ± 0.01^{a}	5.66 ± 0.16^{bc}	3.13± 0.01^{d}	99.83 ±0.01^{a}	0.25 ±0.40^{a}	1.75 ±
JRS3	23 ± 0,9 ^{bc}	25.33 ± 0.01^{b}	5.8± 0,02 7^{d}	158.39 ± 0.01^{a}	5.81 ± 0.06^{c}	2.93± 0.01^{c}	99.10 ± 0.01^{a}	0.89 ± 0.05^{a}	2.03 ±
Cashew apple juice from yellow variety									
JJS0	30± 1,16 ^{d}	24.44 ± 3.85^{b}	5.090± 0,1 ^{a}	175.11 ± 10.58^{bc}	5.48 ± 0.22^{b}	3.08 ± 0.00^{d}	120.36 ± 0.32^{d}	2.52 ± 0.09^{b}	2.52 ±
JJS1	10± 0,32 ^{a}	20.00 ± 6.16^{ab}	5.81 ± 0,04 ^{c}	173.69 ±0.24^{b}	6.68 ± 0.03^{d}	2.92± 0.00^{c}	115.64 ±0.06^{c}	0^{a}	1.03±
JJS2	11.0± 2,5 ^{a}	20.67 ± 0.01^{a}	5.81 ± 0,023 ^{c}	167.22 ± 0.01^{ab}	6.80 ± 0.08^{d}	2.69± 0.01^{b}	108.67 ±0.01^{b}	0.12 ± 0.15^{a}	1.14 ±
JJS3	15± 1,6 ^{ab}	21.04 ± 3. 85^{ab}	5.81 ± 0,04 ^{c}	160.00 ± 21.17^{ab}	6.84 ± 0.32^{d}	2.33± 0.06^{a}	105.46 ±0.01^{b}	0.59 ± 0.41^{a}	3.64 ±

(a,b,c,d,e,f): value with the same superscript letter in the same column are not significantly different (p>0.05). JRS0: Crude red cashew apple juice; JRS1: Red cashew apple juice substituted at 1%; JRS2: Red cashew apple juice substituted at 2%; JRS3: Red cashew apple juice substituted at 3%; JJS0: Crude yellow cashew apple juice; JJS1: Yellow cashew apple juice substituted at 1%; JJS2 : Yellow cashew apple juice substituted at 2% ; JJS3: Yellow cashew apple juice substituted at 3%

.

Turbidity: From the results, the turbidity of cashew apple juice generally increased significantly ($p \leq 0.05$) with the concentration of clarifying agent ("kelle") independently of the variety used. At the same level of "Kelle" concentration, the turbidity of the cashew apple juice from the red variety is higher ($p \leq 0.05$) than that of the yellow one.

Titratable acidity: There was a general decrease of titratable acidity with addition of « kelle » (*B. thermifolia*) in cashew apple juice. This trend seemed to be significant ($p \leq 0.05$) at high concentration especially with the red variety. However, for each variety, all experimental samples presented similar ($p > 0.05$) rate. The same amount of clarifying agent lead to high titratable acidity with red cashew apple juice although, the significant ($p \leq 0.05$) was observed only at 2%. Values obtained are appear to be close to those reported by Dassou (2016) which were between 23 and 59 mg of citric acid/100ml.

pH: Clarifying agent induced pH increasing ($p \leq 0.05$) of the juice. For each variety, all experimental samples had the same ($p > 0.05$) pH value. However, the pH value of red cashew apple juice was greater ($p \leq 0.05$) than that from the yellow cashew apple juice "Kelle".

Vitamin C: The vitamin C of the juice was decreasing with addition of clarifying agent ("Kelle") for each variety. Nevertheless, significant difference ($p \leq 0.05$) was observed at 2 and 3% with juice from the red variety. At equal concentration of "kelle", the vitamin C content of the Cashew apple juice is not affected ($p > 0.05$) by the variety used. Values from this study are lower than obtained by Lautié *et al.* (2001) and Ouattara *et al.* (2016) which were respectively 200-300 mg/100ml and 317.5 mg/100 ml in Ivory Coast.

Total sugars: Addition of clarifying agent increased ($p \leq 0.05$) the total sugars content of the cashew apple juice. The clarified red cashew apple juices showed similar ($p > 0.05$) total sugar content values which were lower ($p \leq 0.05$) than those from the yellow cashew apple juices. Lautier (2011) from his findings, revealed sugar content values of 7.8-8.5 g/100ml, which seem to be lower comparatively to achieved results.

Total carotenoids: "Kelle" as clarifying agent negatively affect the total carotenoids content of cashew apple juice. In fact, it lead to significant ($p \leq 0.05$) reduction of total carotenoids which increase ($p \leq 0.05$) with its amount. The red variety showed significantly ($p \leq 0.05$) high level of carotenoids at the same concentration of clarifying agent. Values obtained are comparable to results reported by Soro (2017) which were 3-5 mg/100 ml.

B-Carotene: As with total carotenoids content, the clarifying agent induced the reduction of β-Carotene content of the juice. This diminution was significant ($p \leq 0.05$) in general. For each variety, clarified juice at 2 and 3% of "Kelle" showed similar ($p > 0.05$) values. Results also revealed that the red variety had low ($p \leq 0.05$) β-Carotene content.

Total tannins: The total tannins content of cashew apple juice was dropping significantly ($p \leq 0.05$) in presence of "Kelle". It was observed comparable ($p > 0.05$) total tannins values with all the experimental samples. Similar tendency was also achieved with crude juices. Values obtained from experimental samples (clarified juices) varied from 0 to 0.89 mg/100ml and seem to be similar to results indicated by Soro (2017) after clarification of cashew apple juice by tangential microfiltration. Tannins are responsible for the enzymatic brownish and astringency (Bruneton, 1999; Iserin, 2001; Abreu *et al.*, 2005; Adou *et al.*, 2012).

Total polyphenols: From the results, the total phenols content of the red cashew apple juice reduced significantly ($p \leq 0.05$) in presence of clarifying agent. On the other hand, concerning the yellow cashew apple juice, significant ($p \leq 0.05$) decrease was achieved at 1 and 2% while at 3% an increase was observed. With the two varieties of cashew apple juice, sample having 3% of "Kelle" indicated high amount ($p \leq 0.05$) of total phenols compare to that having 1%. The values of crude juices obtained seem to be greater than that obtained by Ouattara *et al.* (2016) which was 1.8 mg/100ml.

5 CONCLUSION

The red and yellow cashew apple have similar ($p>0.05$) yield of juice production. The kinetic of clarification of cashew apple juice is improved in presence of "kelle" and at 1%, the best result is achieved. "Kelle" as clarifying agent improves on the colour, taste, astringency and overall acceptability of cashew apple juice. In general, increasing of its concentration reduces the juice quality. It affects the physicochemical properties of the juice. In fact, "Kelle" decreases the total carotenoids, total polyphenols, β-carotene, total tannins, vitamin C and titratable acidity and, increases the turbidity, pH and total sugars contents. In addition, the physicochemical properties of the juice are affected by the cashew apple variety. Clarification of cashew apple juice with bark of *B. thermifolia* or "Kelle" at 1% should be encouraged due especially to its best sensorial properties; high total carotenoids, β-carotene and vitamin C; low tannins and total polyphenols contents.

6 REFERENCES

Aboh A. B., Dougnon J. T., Atchade T., Ghislaine S. et Tandjiekpon A. M., 2011. Effet d'aliments à base de pomme cajou sur les performances pondérale et la carcasse des canetons en croissance au Bénin. *Int. J. Biol. Chem. Sci*., 5(6): 2407-2414.

Abreu F. A. M. P., Dornier M. et Reynes M., 2005. Potentialités de la microfiltration tangentielle sur membranes minérales pour la clarification du jus de pomme de cajou, 60: 33-40.

Aliyu O. M. and Awopetu J. A., 2007. Assessment of genetic diversity in three populations of cashew (*Anacardium occidentale* L.) using protein-isoenzyme electrophoretic analysis. *Genetic Resources and Crop Evolution*, 54: 1489 – 1497. DOI: 10.1007/s10722-006-9138-9.

AOAC. 1984. Official methods of analysis of the Association of Official Analytical Chemists (14th edn) Washington, DC.

AOAC. 1995. Official methods of Analysis of the Association of Official Analytical Chemists Chemists International, (16th edn). *AOAC International Arlington*, VA, 250p.

Assunção R. B., Mercadante A. Z., 2003. Carotenoids and ascorbic acid from cashew apple (*Anacardium occidentale* L.): variety and geographic effects. *Food Chemistry,* 81(4): 495-502.

Brillouet J., 2009. Characterization of highly polymerized prodelphinidins from skin and flesh of four cashew apple (*Anacardium occidentale* L.) genotypes." Food Chemistry 114(3): Bruneton J., 1999. Pharmacologie et phytochimie des plantes médicinales. *Editions médicales internationnales*, Editions Tec & Doc, 1120 p.

De figueiredo R. W., Lajolo F. M., Alves R. E. and Filgueiras H. A. C., 2001. Physical-chemical changes in early dwarf cashew pseudo fruits during development and maturation. *Food Chemistry*, 77: 343 - 347. DOI: https://doi.org/10.1016/S0308-8146(01)00358-2.

Dubois M., Gilles K. A., Hamilton J. K., Roberts P. A. et Smith F., 1956. Colometric method for determination of sugar and related substances. *Anal. Chem*. 28: 350 - 356.

Dossou J., 2008. Test de production de jus de fruits de la pomme cajou au Bénin. Communication à l'atelier sur les acquis de recherches sur le karité, le riz et l'anacarde au Bénin.

Houssou P., Padonou S. W., Dansou V., todohoue C., Agbobatinkpo P., N'djolosse K., Zoffoun A., Gotoechan H., H., Siaka K, Yaï A. C. et Saliou B., 2016. Production du jus de pomme d'anacarde de bonne qualité au Bénin, 24p.

Iserin P., 2001. Larousse Encyclopédie des plantes médicinales, Ed. Larousse, p.10 - 17 et 132 p.

Jeantet R., Croguennec T., Schuck P. et Blulé G., 2006. Science des aliments vol. 1. Stabilisation biologique et physico – chimique. Editions Tec. Doc. Lavoisier, Paris (France). 376 p.

Lacroix E. 2003. Les anacardiers, les noix de cajou et la filière Anacarde à Bassila et au Bénin. Projet Restauration des Ressources Forestières de Bassila, GTZ, République du Bénin, 75 p.

Lautie E., Dorniera M., De Souza F. M. et Reynes M. 2001. Les produits de l'anacardier : caractéristiques, voies de valorisation et marchés. *Fruits.*, 56 (4): 235-248. DOI: https://doi.org/10.1051/fruits : 2001126

Marigo G., 1973. Méthode de fractionnement et d'estimation des composés phénoliques chez les végétaux. *Analusis.,* 2 (2): 106 - 110.

Marlos B. A., Claudivan F., Lacerda D. E., Enéas Gomes F., Carlos de abreu B. and José Prisco T. 2007. Physiology of cashew plants grown under adverse conditions. *Brazilian Journal of Plant Physiology*, 19 (4): 449-461. DOI: 10.1590/S1677-04202007000400012.

Mensah G.A., 2015. Comparaison de quelques techniques d'extraction pour l'amélioration de la production et de la qualité du jus de pommes d'anacarde. *Journal of Applied Biosciences* 96:9063 – 9071.

Michodjehoun-Mestres, L., Souquet J.-M., Fulcrand H., Meudec E., Reynes M. andS Brillouet J. M., 2009. Monomeric phenols of cashew apple (*Anacardium occidentale* L.). *Food Chemistry*, 112: 851-857.

Ouattara G. S., Soro D., Chatigre K. O. et Koffi e. K., 2016. Caractérisation physico-chimique et sensorielle de diverses formulations de jus à base de pomme de cajou et d'ananas. *Int. J. Biol. Chem. Sci.* 10(6): 2447-2460.

Padonou S. W., Houssou P., Karimou K., Todohoue M. C., Olou D., Dossou J. and Mensah G. A. 2015. Comparaison de quelques techniques d'extraction pour l'amélioration de la production et de la qualité du jus de pommes d'anacarde. *Journal of Applied Biosciences* ; 96: 9063 – 9071.

Sali B., Madou C., Nome A. et Kuate J., 2020. Caractérisation socio-économique des grands bassins de productions d'anacardiers (*Anacardium occidentale*) et étude comportementale de leur peuplement dans le Cameroun septentrional, *Int. J. Biol. Chem. Sci.* 14(6): 2094-2111.

Saidou C., 2012. Propriétés physico-chimiques et fonctionnelles des gommes hydrocolloïdes des écorces de *Triumfetta cordifolia* et *Bridelia thermifolia.*

Soro D., 2008. Concentration par microfiltration tangentielle et caractérisation d'extraits carotenoïdiques de pomme de cajou. Institut des régions chaudes. Master Recherche Naval, Montpellier, *Sup. Agro*, 67p.

Soro D., 2012. Couplage de procédés membranaires pour la clarification et la concentration du jus de pomme de cajou : performances et impacts sur la qualité des produits, Thèse de doctorat, Université de Montpellier Sup Agro, 156 p.

Vinson J. A., Yong A., Xuelci S. and Ligid Z, Bose P. 2001. Phenol antioxidant, quantity, and quality in foods. *J Agric Food Chem.*, 49: 5315–5322.

Zouffoun A., 2017. Potentialités de la microfiltration tangentielle sur membranes minérales pour la clarification du jus de pomme de cajou. Fruits. 60: 33-40.