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Quality assessment of pineapple (*Ananas comosus* (L.) Merr.) Flavoured whey drink

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Abstract
This study was conducted to produce pineapple flavoured whey drink and assess its physicochemical, microbial and sensory quality. Four samples were prepared by addition of 0%, 10%, 20% and 30% (v/v) of pineapple juice to whey drink. Results show that titratable acidity, dry matter, ash and vitamin C were increasing with addition of pineapple juice. On the other hand, pH and fat were reducing but no effect was observed for the sugar content. During storage, for all the drinks produced, pH reduced while titratable acidity increased. The pineapple juice caused a reduction of yeasts and moulds count but no effect was observed for the total plate count. It improved sensory property of whey drink in general and significantly at 30% and 20% in terms of consistency and colour, respectively. Flavouring whey with 30% of pineapple juice could be recommended.

Keywords: Pineapple juice; whey drink; storage; physicochemical, microbial and sensory properties

Introduction
Pineapple (*Ananas comosus* (L.) Merr.), holds the third rank in the world tropical fruit production [1]. It is a source of essential minerals and vitamins with some medicinal values [2]. Pineapple has considerable amount of calcium, potassium, magnesium, fibres and vitamin C and has low fat content [2-4]. It is a digestive aid and demonstrated some therapeutic characteristics [3] and endowed antioxidant capacity due to the presence of phenolic compounds, flavonoid compounds and ascorbic acid [4]. Also, it contains bromelain which helps digestion and demonstrated other health benefits [3, 5].
Whey is the aqueous fraction produced in large amounts as a sub-product in the cheese-making process. It is nutritionally good with numerous potentially beneficial effects on human health [6]. Whey is an excellent source of functional proteins and peptides, vitamins, minerals and lactose [6]. The biological value of its proteins is approximately 15% higher comparatively to egg which was regarded as a reference considering the essential amino acid profile [7]. In addition, they are often associated to health promoting properties [8, 9]. Whey is also characterised by its strong polluting power [10]. The dairy industry suffers from an economic loss due to its improper disposal [11]. However, the production of whey-based beverages proved to be the most economical and simple way of exploitation [12, 13].
Pineapple could be incorporated in whey [14]. Also, its good flavour, aroma, juiciness and sweetness are well known and appreciated by consumers [3, 15]. Development of pineapple flavoured whey drink could be a strategy to improve its consumption and reduce environmental pollution. The present study was to investigate on the physicochemical, microbial and sensory properties of pineapple flavoured whey drink.

Material and methods
Preparation of pineapple juice
Fresh ripe pineapple from Njombe (Littoral Region, Cameroon) was purchased in Bamenda food market, North-West Region, Cameroon and brought to the Food Technology and Post-Harvest Laboratory of IRAD-Bambui, North-West Region, Cameroon. The fruits were washed several times using tap water, peeled, the core and dark spots removed before slicing

and blending. The puree obtained was squeezed using a muslin cloth and, the extracted juice kept in the refrigerator (4-8 °C) for direct use.

Whey collection

Whey was collected from cheese production after curd separation by draining using a cheese cloth. The milk was pasteurised (72 °C for 3-5 s) and coagulation obtained by addition of cheese starter culture (1%) and rennet solution (0.03%).

Preparation of pineapple flavoured whey drink

The collected whey was pasteurised at 75 °C for 10-15 s in presence of corn starch (1.5% (w/v)), sugar (8% (w/v)) and pineapple juice. The drink was then cooled at room temperature, packaged and kept in the refrigerator (4-8 °C) for analyses. Four whey drink samples were obtained by addition of 0%, 10%, 20% and 30% (v/v) of pineapple juice respectively for samples A, B, C and D.

Physicochemical analysis

The physicochemical parameters analysed were pH using a pH-Meter; titratable acidity (% lactic acid), dry matter, ash, and fat according to the standard AOAC methods [16]; sugar (°Brix) using an eclipse refractometer and vitamin C by redox titration using iodine with starch as indicator. pH and titratable acidity of whey drink were determined during 20 days' storage at 5 days' intervals.

Microbial analysis

Microbial analysis consisted of enumeration of total bacteria count, total coliform count and yeasts and moulds count [17].

Sensory evaluation

Samples were sensorial evaluated for colour, taste, aroma/smell, consistency and overall acceptability by 25 semi-trained panellists and using a 5-point hedonic scale.

Data analysis

Data collected were expressed as Mean ± SD and subjected to analysis of variance (one-way ANOVA) using the Statgraphics Plus, version 5.0 statistical package. Means obtained were separated using the Fischer test (LSD) at 95% confidence level.

Results and discussion

Physicochemical properties of pineapple juice (PJ) and whey drink

The physicochemical properties of pineapple juice and whey are presented in table 1.

Table 1: Physicochemical Composition of raw materials

Parameters	Whey	Pineapple juice
pH	5.27 ± 0.13^{a}	3.24 ± 0.39^{b}
Titratable acidity (% Lactic acid)	0.52 ± 0.09^{b}	0.95 ± 0.15^{a}
Dry mater (%)	6.21 ± 0.15^{b}	7.96 ± 0.27^{a}
Ash (%)	0.31 ± 0.12^{b}	0.53 ± 0.14^{a}
Sugar (°Brix)	4.50 ± 0.24^{b}	15.5 ± 0.58^{a}

(^{a,b}); values with different superscript letters in the same column are significantly different (P<0.05)

Physicochemical properties of pineapple flavoured whey drink (PFWD)

Flavouring whey drink with pineapple juice (PJ) resulted to significant (P<0.05) pH reduction (table 2). Meanwhile titratable acidity increased with PJ concentration. This is in line with previous results [17-20]. It could be as results of acidic character of pineapple and its organic acids.

Dry matter and ash contents increased (P<0.05) in presence of PJ respectively at 30% and from 20%. Generally, increasing PJ concentration was associated with that of those parameters. This could be related to their high contents in pineapple juice compare to whey (table1); which is in accordance with previous studies [20, 21]. Likewise, vitamin C was greater by increasing the ratio of PJ and could be associated to its content in pineapple. Previous studies obtained similar relationship [18, 20, 21]. The low fat content with increasing of PJ concentration might be as result of low fat content of pineapple [17].

Table 2: Physicochemical properties of PFWD

Parameters	Samples			
	A	**B**	**C**	**D**
pH	5.26 ± 0.11^{a}	4.82 ± 0.03^{b}	4.55 ± 0.23^{b}	4.37 ± 0.29^{b}
Titratable acidity (% lactic acid)	0.50 ± 0.02^{d}	0.59 ± 0.02^{c}	0.72 ± 0.01^{b}	0.82 ± 0.01^{a}
Dry matter (%)	14.47 ± 0.65^{b}	14.78 ± 0.29^{b}	15.14 ± 0.60^{ab}	15.99 ± 0.82^{a}
Ash (%)	0.36 ± 0.02^{c}	0.43 ± 0.01^{c}	0.50 ± 0.06^{b}	0.62 ± 0.03^{a}
Fat (%)	0.46 ± 0.07^{a}	0.23 ± 0.07^{b}	0.14 ± 0.07^{bc}	0.10 ± 0.00^{c}
Sugar (°Brix)	13.33 ± 0.58^{a}	14.33 ± 0.58^{a}	14.33 ± 0.58^{a}	14.50 ± 0.87^{a}
Vitamin C (mg/100ml)	9.53 ± 0.25^{c}	11.58 ± 0.25^{b}	12.17 ± 0.50^{b}	13.93 ± 1.11^{a}

(^{a,b,c,d}): Values with different superscript letters in the same column are significantly different (P<0.05)

A: 0% pineapple; B: 10% pineapple; C: 20% pineapple; D: 30% pineapple

3.3 Change in PFWD during storage

The pH of all samples decreased during storage (figure 1) while the titratable acidity increased (figure 2). Also, a significant difference (P<0.05) was observed between initial and final values. These results are in agreement with previous findings [18, 19, 22] and could be attributed to the acid production during storage and formation of organic acids.

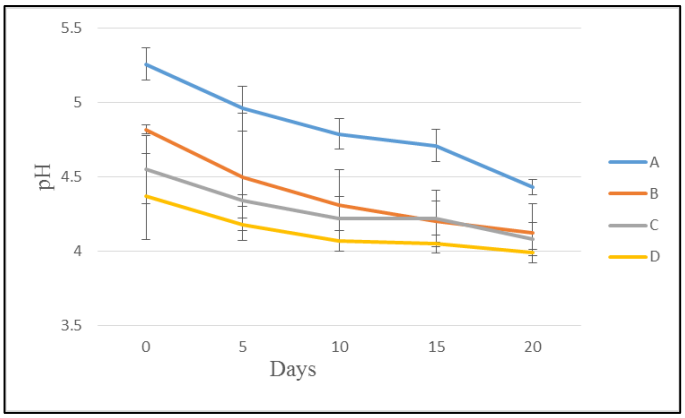

Fig. 1: Change in pH of PFWD during storage

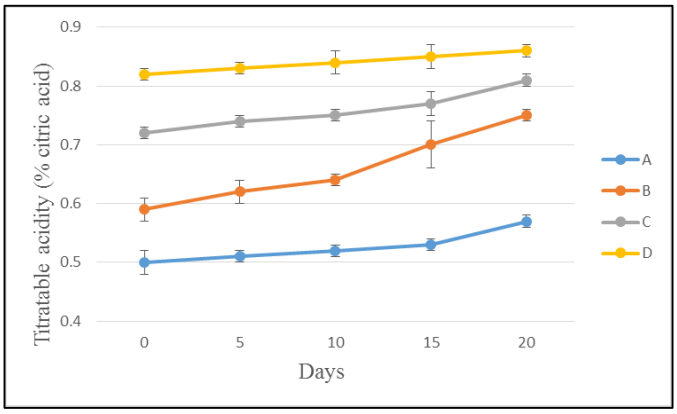

Fig. 2: Change in titratable acidity of PFWD during storage

3.4 Microbial properties of PFWD

Total bacteria count was not affected (P>0.05) by flavouring while yeasts and moulds count significantly (P<0.05) reduced (table 3). All the experimental samples had similar (P>0.05) yeasts and moulds count. The reduction of yeasts and moulds count observed could be due to the antibacterial effect of bromelain [17].

Table 3: Microbial properties of pineapple flavoured whey drink

Samples	Total bacteria Count ($\times 10^3$ cfu/ml)	Total Coliforms count ($\times 10^1$ cfu/ml)	Yeast and Moulds count ($\times 10^2$ cfu/ml)
A	3.33 ± 2.30^{a}	<1	10.66 ± 3.05^{a}
B	1.46 ± 0.23^{a}	<1	3.67 ± 0.57^{b}
C	1.33 ± 0.57^{a}	<1	3.00 ± 1.73^{b}
D	2.0 ± 1.73^{a}	<1	2.33 ± 0.57^{b}

(^{a,b}): Values with different superscript letters in the same column are significantly different (P<0.05)

3.5 Sensory evaluation

Pineapple juice as flavouring did not affect (P>0.05) the aroma, taste and overall acceptability of whey drink (table 4). Colour was more (P<0.05) appreciated for sample with 20% pineapple juice and for consistency, sample at 30% was considered (P<0.05) the best. In general, addition of pineapple juice led to an improvement in its sensory properties. Similar results were obtained with guava whey blend beverages [18].

Table 4: Sensory evaluation score of PFWD

Samples	Colour	aroma	Consistency	Taste	Overall acceptability
A	3.04 ± 1.17^{b}	3.12 ± 1.33^{a}	2.92 ± 1.28^{b}	3.32 ± 1.40^{a}	3.40 ± 1.25^{a}
B	3.20 ± 0.91^{ab}	2.72 ± 1.13^{a}	3.24 ± 1.01^{ab}	3.08 ± 1.07^{a}	3.60 ± 0.91^{a}
C	3.72 ± 1.17^{a}	3.32 ± 0.94^{a}	3.40 ± 1.08^{ab}	3.52 ± 0.96^{a}	4.00 ± 0.86^{a}
D	3.44 ± 1.38^{ab}	3.28 ± 1.30^{a}	3.60 ± 1.32^{a}	3.60 ± 1.32^{a}	3.84 ± 1.21^{a}

(^{a,b}): Values with different superscript letters in the same column are significantly different (P<0.05)

Conclusion

From the study, pineapple juice at 30% (v/v) in whey drink induces the lowest fat content and the highest vitamin C, ash and dry matter contents. During storage, the pH of all samples decreases while the titratable acidity increases. Pineapple juice reduces the yeasts and moulds count but not affect the total bacterial count of whey drink. It enhances the sensory properties of whey drink although not significantly.

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