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ORIGINAL ARTICLE

Physicochemical, Rheological and Sensory Attributes of Honey Sweetened Jam Produced from Blends of Carrot and Cucumber

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Abstract

This study evaluate the physicochemical properties, rheological characteristics, and consumer acceptability of Jam produced from blend of carrot (CT) and cucumber (CB),sweetened with honey at varying proportions : C10 (100% CT), C91 (90% CT, 10% CB) , C82 (80%CT, 20% CB), C73(70% CT, 30%CB), C64 (60%CT, 40%CB), C55 (50%CT, 50%CB, C46 (40% CT, 60% CB), C37: 30%CT, 70% CB, C28 (20%CT, 80% CB) C19 (10%CT, 90%CB) and ,C01 (100 CB), respectively. The proximate composition, physicochemical properties and rheological characteristics were evaluated using standards methods and sensory evaluation as well conducted. There were significant differences ($p<0.05$) between the values obtained for moisture, protein, ash, fiber, fat and carbohydrate contents. These ranged from 52.67-72%, 1.32-1.94%, 0.28-2.32%, 0.14-1.05%, 0.11-0.93%, 24.89-44.41%, respectively. Also, significant differences ($p<0.05$) existed between values obtained for vitamin C, total sugar, Total titrable acidity, Brix° and pH, respectively. Application of power law model revealed a pseudo-plastic behavior for all the Jams samples with flow index of $n<1$. Inference drawn from the panelist scores revealed that scores for sensory parameters were not significantly different ($p>0.05$). There was higher average scored values for all the parameters rated by panelist for jams produced from 100% carrot. The study showed that jams (Carrot-cucumber jam sweetened with honey) is a good source of energy. The level of fat and total sugar content of these fruit jams indicated the suitability for children, elderly, diabetic patient and obese.

Practical application

The focus of this work, carrot-cucumber jam sweetened with honey is with the focus of attending to the inability of accessing the nutritional and health beneficial components as a result of postharvest losses associated with cucumber and carrots widely grown in the country. This is easily solved by processing into products (jam) that can easily be stored and yield it benefits whenever to variety of consumers: children, obese, elderly and diabetic patients

Keywords: Carrot, Cucumber, Jam, Honey, Nutrition, Rheological properties

1. Introduction

The need to consume health related foods were adequately suggested in the literatures (Oomah & Mazza, 2000; Hoejskov, 2014; Amao, 2018). Fruits and vegetables were severally recommended as health promoting foods aside the basic nutritional provision (Hoejskov, 2014; Amao, 2018; Bellavia *et al.*, 2013). According to some researchers, they also reduce the risk of diseases (Boffetta *et al.*, 2010; Bellavia *et al.*, 2013; Oyebode *et al.*, 2014; Conner *et al.*, 2017; Amao, 2018). Fruits and vegetables have been reported to contain vitamins, minerals and phytochemicals (Babajide *et al.*, 2013; Oyebode *et al.*, 2014; Amao, 2018; Payne *et al.*, 2012; Yeon *et al.*, 2012; Sahu & Sahu, 2015).

The general awareness of fruits and vegetables consumption is increasing through public education campaign and recommendation by doctors and dieteticians (Silva *et al.*, 2017). However, the inability to preserve them in their fresh forms for a long period of time requires conversion into a more stable product without the loss of the relevant nutritional and mineral contents. According to FAO (2015), about 40-45% post-harvest losses of fruits and vegetables are often experienced yearly. The consumption and processing of fruits and vegetables depend on the availability. It is difficult to access all fruits and vegetables at the same time. Some are peculiar to locality and season. Except there are effective storage techniques, the benefit of fruits and vegetables may not be harnessed. Processing into secondary products which can be effectively stored are good ways of harnessing the nutritional and health benefits of fruits and vegetables all the time. Processing into juices and jams are good ways of preserving the fruits and vegetables for future consumptions, thereby delivering their benefits even when out of seasons. Among many fruits and vegetables in Nigeria, cucumber and carrots are grown on a large scale and generate sustainable income for many people. Production is however not independent of the demand for this fruits. Unfortunately, difficulties in storage necessitate the processing or conversion into jam which can be stored in the refrigerator compared with their natural form. According to the findings of Kim & Padilla-Zakour (2004), processing fruits and vegetables into Jam help to retain the phenolics and antioxidant in anthocyanin rich fruits and vegetables.

Jams appear in many forms: jellies, marmalades, chutneys, fruit butters and fruit spreads (Shen *et al.*, 2012). They are also useful accompaniments to peanut butter, blended with milk, fresh fruit, and yoghurt, spread between cake layers, filled into doughnuts (Shen *et al.*, 2012; Babajide *et al.*, 2013).

The carrot-cucumber juice produced and evaluated by Aderinola & Abaire (2019) had high moisture content which definitely cannot function as bread spread like jam. Also, the juices were produced on just five varying proportions. However, the fact that substantial amount of antioxidant was found in the blends of carrot and cucumber juices, suggested the use for Carrot-cucumber jam with addition of honey.

Cucumbers are scientifically known as *Cucumis sativus* and are a valuable source of conventional antioxidant nutrients including vitamin C, beta-carotene, and manganese (Nema *et al.*, 2011). The Phytochemical and therapeutic potential of cucumber was reported by Mukherjee *et al.* (2013). Cucumber was reported by Sahu & Sahu (2015) to contain pharmacological potentials like anti-bacterial activity, antifungal activity, cytotoxic activity, antacid and carminative activity. According to some researcher's findings, cucumber contains biologically active and non-nutritive compounds known as phytochemicals. These phytochemicals (alkanoids, flavonoids, tannins, phlabotannins, steroids and saponins) contain antioxidants which have potential to reduce risk of several deadly diseases (Oomah & Mazza, 2000; Samarghandian *et al.*, 2017; Aderinola & Abaire 2019).

Carrot (*Daucus carota subsp. sativus*) is a root vegetable and reported to contain high quantities of alpha- and beta-carotene, good source of vitamin K and vitamin B6 (Hager & Howard, 2006). Findings revealed that carrot contain plant component metabolite called phytonutrients which have health promoting properties (Hashimoto & Nagayama, 2004; Hager & Howard, 2006).

Honey obtained from bees is used as a sweetening material mostly obtained from Bees (Bansal et al., 2005; Babacan & Rand, 2007). It was also reported that Honey sweetness is derived from monosaccharide, fructose and glucose (Babacan & Rand, 2007; Attia et *al.*, 2008; Bogdanov *et al.*, 2008). It has been established that honey have some health benefits (Bansal *et al.*, 2005; Babacan & Rand, 2007; Attia *et al.*, 2008).

There is a need for the development of some nutritional and health beneficial foods by the combination of indigenously grown fruits and vegetables, especially under-utilized ones. Fruits and vegetables are susceptible to post harvest losses (FAO 2015; Kim & Padilla-Zakour, 2004). This post-harvest processing helps in preservation of important health beneficial components. Carrot-cucumber jam sweetened with honey has tendency to increase the nutritional intake and provide health benefits when accompanying bread consumption especially for children and diabetic patient. Carrot-cucumber jam will be alternative form of deriving the benefits of the phytochemicals, phytonutrients and antioxidant components resident in this fruit and vegetable. Therefore, it is necessary to establish the effect of the proportion of mixtures and processing on the physicochemical, rheological behavior, sensory responses and proximate composition of carrot-cucumber jam sweetened with honey. These properties will be relevant in handling and storage of the product.

2. Materials and Methods

Cucumbers, carrots and honey used in the preparation of Jam were procured from Sabo, Mile 12 while pectin was obtained from certified vendor in Ojota market in Ikorodu, Lagos State. Wholesome cucumbers and carrots were selected and washed. The grated cucumber, sliced and blended carrot were measured and mixed in the selected proportions of C10 (100% CT), C91 (90% CT, 10% CB) , C82 (80%CT, 20% CB), C73(70% CT, 30%CB), C64 (60%CT, 40%CB), C55 (50%CT, 50%CB, C46 (40% CT, 60% CB), C37: 30%CT, 70% CB, C28 (20%CT, 80% CB) C19 (10%CT, 90%CB) and ,C01 (100 CB), respectively. Water (250 ml), honey (125 ml) and pectin (75 ml) were added to the mixture of blended carrots and cucumber, mixed properly. The required values were determined from preliminary study. It was allowed to boil for 5 min. mixed and was quickly filled into already sterilized glass jars. The process diagram is as shown in figure 1. The glass jars were placed in boiling water and allowed to boil for additional 5 min and sealed.

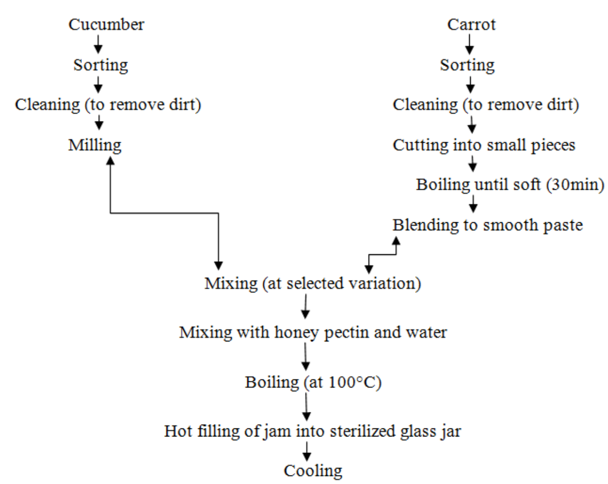

Figure 1: Process flow diagram of Carrot-cucumber jam

2.1. Physico-chemical properties

The physico-chemical properties (Brix°, refractive index (RI), pH, total acidity, vitamin C and total sugar) were determined according to standard methods (AOAC, 1990).

2.1.1. Determination of vitamin C

The method documented by AOAC (1990) was employed. In this case, 2,6- dichlorophenol indophenol titration procedure was used. Acetic acid and metaphosphoric acid solution were used to extract the Ascorbic acid. The extracts were subsequently transferred into 50 mL volumetric flask and mixed with distilled water and filtered rapidly. The filtrate was released from a burette into a test tube containing one drop of dilute acetic acid and 1 mL of the redox dye, 2,6 dichlorophenolindophenols solution at a controlled rate. The volume of the extract required to decolorize the dye was noted. The titration was repeated using standard ascorbic acid solution (1 mg pure vitamin C per 100 mL) in place of fruit Jam extracts (AOAC, 1990). Vitamin C per 100 g of jam was calculated using Equation (1)

$$\%\ \boldsymbol{ascorbic\ acid} = \frac{\boldsymbol{V\times 100}}{\mathbf{100}} \quad (1)$$

Where V is the volume of the extract required to decolorize the dye

2.1.2. Determination of Total sugar

Total sugar was determined by dissolving 2 g of sample in 250 mL of distilled water. About 1 mL of solution was diluted with 100 mL of distilled water in a beaker. 1 mL of the diluted solution was pipetted into a test-tube and 1 mL of 5% phenol was added in drops. The content was transferred into clean, grease-free cuvette after 10 min. and reading was taken with spectrophotometer at 490 nm. A blank was prepared as above to calibrate the equipment and %total sugar computed as shown in Equation (2).

$$\%\ \boldsymbol{total\ sugar} = \frac{(\textbf{sample concentration} * \textbf{dilution factor})}{\mathbf{10000}} \quad (2)$$

2.1.3. Total titrable acid

The total titrable acidity was determined by method described by Ajenifujah-Solebo & Aina (2011). One gram (1 g) of blended Jam was dissolved in 20 mL distilled water, three drops of Phenolphthalein indicator were added and was titrated with 0.1 N NaOH till pink colour appeared. Titrable acidity was estimated with the aid of Equation (3).

$$\boldsymbol{T_a} = \frac{\boldsymbol{B}\times\mathbf{0.1}\times\mathbf{0.064}\times\mathbf{100}}{\boldsymbol{w}} \quad (3)$$

Where, T_a is total titrable acidity; B is burette reading, w is weight of sample.

2.1.4. Brix Value

Abbey refractometer was used to determine the Brix value. Lime was added to adjust the pH to 3.2 and further heated to remove excess water from the lime.

2.1.5. pH

The pH value of the sample was measured with a digital glass electrode pH meter (CD 175 E) at room temperature. The pH meter was calibrated prior to sample pH measurement using buffer solutions of pH value 4.0 and 7.0.

2.2. Proximate and nutritional analysis of carrot and cucumber jam

The proximate parameters of the fruit jam evaluated were moisture, protein, ash content, crude fiber, fat and carbohydrate content. These were carried out using methods described by AOAC (1990).

2.3. Rheological properties determination

The viscosities of different jam samples were measured in triplicates at room temperature using a digital rotational NDJ-86 Viscometer. The readings were taken after 10, 15, 20, 25 and 30 sec, respectively using rotational spindle size of 1 and speed rotation of 12, 30, and 60 rpm. The samples were poured into the 250 mL beaker to a level that covers the immersion grove of the spindle shaft. The shear stress was computed from the viscosity determined. The Shear stress was plotted against the shear rate using the power law model to describe the data of shear-thinning and shear thickening of respective Jam samples as shown in Equation (4). This was linearized in equation (5).

$$\sigma = k\,\gamma^{n} \qquad (4)$$

$$\log \sigma = \log K + n \log\gamma \qquad (5)$$

where, k is the consistency coefficient with the units N/m^2s, σ is the shear stress at a shear rate of 1.0 s^{-1} and the exponent n, is dimensionless flow behaviour index. Newtonian fluid's behaviour is expected to have n = 1, the consistency index k is identically equal to the viscosity of the fluid, η.

2.4. Sensory evaluation of carrot-cucumber jam sweetened with honey

Sensory evaluation was carried out on the carrot-cucumber jam sweetened with honey using a nine point–hedonic scale where 1 represent extremely disliked and 9 liked extremely. Thirty (30) panelists were selected based on their availability and familiarity with jam products. The parameters evaluated were colour, taste, flavour, spread ability and overall acceptability. The data were statistically analysed.

2.5. Statistical analysis

The data obtained in this work were statistically analyzed using SPSS version 17. The Analysis of variance (ANOVA) was conducted and where significant difference existed, means were separated using Duncan multiple range test.

3. Results and Discussion

3.1. Physicochemical properties of Carrot-cucumber Jam sweetened with honey

The physicochemical properties of carrot-cucumber Jam sweetened with honey (Vitamin C, total sugar, titrable acidity, Brix, and pH value) are as shown in Table 1. Vitamin C content ranged from 0.65-4.35%. These values were similar to values reported for grape Jam having 2.65% and apricot jam with 5.67% (Mohd-Naeem *et al.*, 2017). According previous works, thermal processing of fruits into jams can affect vitamin C (Uckiah *et al.*, 2009; Valente *et al.*, 2014).

The total sugar contents obtained in this work were lower compared with values reported by Touati *et al.* (2014) for apricot. The total titrable acidity ranged from 0.18 to 0.67 and were similar to values reported by Ajenifujah-Solebo & Aina (2011) for black-plum fruit. The Brix° content for the jam samples differ significantly from some values recorded in previous study while the pH values ranged from 3.36 to 3.98 and similar to black-plum fruit (Muhammed *et al.*, 2011; Ajenifujah-Solebo & Aina, 2011).

3.2. Proximate composition of Carrot-cucumber jam sweetened with honey

The result of the proximate composition of carrot-cucumber jam sweetened with honey is as shown in Table 2. Moisture and protein content ranged from 53-72% and 1.32-1.94%, respectively. According to some researchers, variation in the moisture content of carrot and cucumber jam can be attributed to the stage of maturity of the fruit and vegetables, moisture content of respective fruits and vegetables before blending together. This was obviously justified by the samples with higher percentage of cucumber addition (Eke-Ejiofor & Owuno, 2013; Saka *et al.*, 2007; Awolu *et al.*, 2018; Amao, 2018). There was a decrease in protein content with increased carrot proportion. These values were however low when compared with values reported for three samples of Jam from blend of Banana, Pineapple and Watermelon Pulp (Awolu *et al.*, 2018). There was no significant difference (p>0.05) in protein content of samples C10 (100% carrot), C28 (20% carrot, 80% cucumber), C19 (10% carrot, 90% cucumber) and C01 (100% cucumber).There was a decrease in ash content with increase in cucumber addition. The crude fibre content ranged from 0.14 -1.05 %. These values were similar compared to those values reported for plum and guava Jam and *Napoleona imperialis* fruit (Okudu *et al.* 2016; Alaekwu & Mojekwu, 2013). The carbohydrate content recorded in this work was higher than values reported for pineapple and jackfruit jams (Eke-Ejiofor & Owuno, 2013; Okudu & Ene-Obong, 2015).

Table 1: Physicochemical properties of Honey sweetened Jam produced from Carrot-cucumber blends

Jam samples	Vitamin C (%)	Total sugar (%)	TTA	Brix	pH
C10	4.35±0.15[a]	24.82±2.66[a]	0.47±0.08[c]	23.00±1.00[de]	3.74±0.01[f]
C91	4.01±0.12[a]	34.27±16.85[c]	0.67±0.05[c]	29.00±1.00[cd]	3.49±0.10[e]
C82	2.32±0.26[b]	36.20±12.50[bc]	0.42±0.14[ab]	33.00±1.00[ab]	3.36±0.10[cd]
C73	2.99±0.27[c]	48.09±2.78[bc]	0.42±0.00[d]	21.00±1.00[ab]	3.61±0.01[i]
C64	2.92±0.06[cd]	42.73±8.35[bc]	0.47±0.08[bc]	25.00±1.00[ab]	3.89±0.01[d]
C55	2.64±0.27[cde]	44.57±6.55[bc]	0.42±0.00[bc]	20.00±1.00[bc]	3.65±0.05[c]
C46	2.48±0.03[de]	45.42±2.92[bc]	0.18±0.08[a]	41.00±1.00[h]	3.84±0/01[g]
C37	1.69±0.65[e]	45.43±5.01[bc]	0.42±0.14[bc]	22.00±1.00[a]	3.59±0.01[de]
C28	0.98±0.18[f]	48.32±5.03[bc]	0.44±0.28[cd]	21.00±1.00[d]	3.98±0.01[h]
C19	0.86±0.02[f]	46.30±0.00[ab]	0.28±0.00[bc]	21.00±1.00[g]	3.60±0.01[a]
C01	0.65±0.06[a]	51.20±2.55[ab]	0.45±0.05[d]	23.00±1.00[f]	3.66±0.01[b]

C10: 100% Carrot, C91: 90% Carrot, 10% Cucumber , C82: 80% Carrot, 20% Cucumber, C73: 70% Carrot, 30% Cucumber, C64: 60% Carrot, 40% Cucumber, C55: 50% Carrot, 50% Cucumber , C46: 40% Carrot, 60% Cucumber, C37: 30% Carrot, 70% Cucumber, C28: 20% Carrot, 80% Cucumber C19: 10% Carrot, 90% Cucumber,C01: 100% Cucumber

3.3. Rheological o properties of Carrot-cucumber jam sweetened with honey

The viscosity of jam samples result is as shown in Table 3.The result revealed that the viscosities of Carrot-cucumber jam mostly decreased with increase in time, spindle speed and reduction of carrot proportion. The viscosities values obtained were higher than 400 mpa/s for carrot-cucumber jam sweetened with honey at the ratio of 100:0 (435.35-477.15 mpa/s), 90:10 (504.60-517.00 mpa/s) and 82:20 (411.60-497.65mpa/s) at lower spindle speed of 12-rpm. Lower values of viscosities were recorded for Spindle speed of 60 rpm. Lower values of viscosities were recorded honey showed a non- Newtonian behavior with pseudoplastic characteristics (n<1).

The yield stress (γ) as shown in figure 2 decreased with increase in spindle speed. Similar observation was reported by Santanu & Shivhare (2010) for mango, apricot, strawberry, peach and raspberry fruit Jam. The linear graph figure 2, exhibited pseudoplastic flow.

Table 2: Proximate composition of Honey sweetened Jam produced from Carrot-cucumber blends

Jam samples	Moisture (%)	Protein (%)	Ash (%)	Fiber (%)	Fat (%)	Carbohydrate (%)
C10	53.17±1.60^{c}	1.84±0.16^{bcd}	0.058±0.14^{a}	0.29±0.07^{a}	0.23±0.06^{a}	44.41±0.20^{j}
C91	60.83±2.75^{ab}	1.80±0.09^{cd}	2.32±0.33^{a}	1.05±0.15^{a}	0.93±0.13^{a}	33.07±0.02^{e}
C82	52.67±1.8^{9cd}	1.76±0.21d	2.05±0.31^{a}	0.93±0.14^{a}	0.82±0.12^{a}	41.77±0.12^{i}
C73	68.67±2.36^{de}	1.32±0.28^{d}	0.28±0.06^{bc}	0.14±0.03^{bc}	0.11±0.02^{bc}	29.48±0.22^{c}
C64	56.50±3.50^{e}	1.73±0.08^{a}	0.050±0.00^{a}	0.25±0.00^{bc}	0.20±0.00^{a}	41.27±0.20^{i}
C55	63.33±3.40^{f}	1.63±0.04^{ab}	1.00±0.00^{a}	0.050±0.00^{a}	0.40±0.00^{a}	33.59±0.02^{ef}
C46	72.00±0.05^{d}	1.53±0.13^{abc}	0.833±0.29^{a}	0.417±0.14^{a}	0.33±0.12^{a}	24.89±0.01^{a}
C37	69.83±0.76^{ab}	1.48±0.03^{abcd}	0.67±0.29^{ab}	0.33±1.44^{ab}	0.27±0.11^{ab}	27.42±0.21^{b}
C28	64.33±1.76^{a}	1.94±0.05^{bcd}	1.83±1.44^{a}	0.92±0.72^{a}	0.73±0.058^{a}	30.25±0.20^{d}
C19	58.17±2.8^{4bc}	1.91±0.34^{bcd}	0.75±0.43^{c}	0.37±0.22^{bc}	0.30±0.17^{c}	38.52±0.02^{h}
C01	63.11±4.59^{bc}	1.75±0.03^{bcd}	0.050±0.00^{c}	0.25±0.00^{c}	0.20±0.00^{c}	34.65±0.01^{fg}

C10: 100% Carrot, C91: 90% Carrot, 10% Cucumber , C82: 80% Carrot, 20% Cucumber, C73: 70% Carrot, 30% Cucumber, C64: 60% Carrot, 40% Cucumber, C55: 50% Carrot, 50% Cucumber , C46: 40% Carrot, 60% Cucumber, C37: 30% Carrot, 70% Cucumber, C28: 20% Carrot, 80% Cucumber C19: 10% Carrot, 90% Cucumber,C01: 100% Cucumber

subsequently at spindle speed of 12 rpm as the carrot proportion decreased. The application of the power law ($\boldsymbol{\mu = k\gamma}^{n}$) model on rheological parameters of the jam samples in this work gave a good fit. At the varying spindle speed revolution of 12, 30 and 60 rpm it was revealed as shown in the statistical parameter in Table 4 that all Carrot-cucumber jam sweetened with

Similar trends were observed by (Xin-Gao *et al.*, 2011) for four kinds of jams (kewpie, strawberry, marmalade, ST Dalfour).

3.4. Sensory evaluation

The organoleptic tests are always a necessary guide of the quality from the consumer's point of view (David & Stuart, 2002). The results of sensory evaluation of carrot and cucumber jam samples are as shown in figure 3. Sensory scores by the panelist for taste (5.45-6.85) decreased with increase in the proportion of cucumber in the jam samples. There was no significant difference (p>0.05) found in samples C91(carrot 90%, cucumber 10%), C82 (80% carrot, 20% cucumber), C73 (70% carrot, 30% cucumber), C64 (60% carrot, 40% cucumber), C55(50% carrot, 50% cucumber), C46 (40% carrot, 60% cucumber), C37 (30% carrot, 70% cucumber), C28 (20% carrot, 80% cucumber) and C19 (10% carrot, 90% cucumber). The panelist scores for colour in sample C10 may be due to its high carotenoid content (Hager & Howard, 2006; Amao, 2018). The flavour ranged from 5.60- 6.80, the score for flavour of sample C10 (100% carrot) was significantly higher than other samples while for C46 (40% carrot, 60%

Table 3: Viscosities (mpa/s) of Honey sweetened Jam produced from Carrot-cucumber blends

Jam samples	Time (sec.)	12-rpm (mpa/s)	30-rpm (mpa/s)	60-rpm (mpa/s)	**Sample**	12-rpm (mpa/s)	30-rpm (mpa/s)	60-rpm (mpa/s)
C10	10	477.15	167.05	97.95	**C91**	517.00	205.95	103.00
	15	467.55	169.15	100.00		502.00	205.90	103.00
	20	463.30	171.35	97.20		514.90	205.80	103.00
	25	459.50	169.45	102.30		511.70	205.80	103.9
	30	435.35	168.30	104.20		504.60	205.85	103.9
C82	10	411.60	208.05	104.10	**C73**	170.15	95.20	68.60
	15	489.85	208.05	104.10		182.40	97.35	67.90
	20	493.40	208.05	104.05		175.70	99.15	68.10
	25	493.40	208.05	104.050		180.30	99.55	68.15
	30	497.65	208.05	104.050		176.65	99.10	69.35
C55	10	283.60	156.77	102.90	**C64**	283.50	186.15	104.15
	15	279.45	154.55	104.15		319.15	180.00	104.15
	20	282.75	154.45	103.20		321.40	179.05	104.15
	25	281.60	154.95	103.70		317.45	178.05	104.15
	30	286.30	156.05	103.80		315.35	176.80	104.15
C46	10	136.20	62.40	41.95	**C37**	292.35	155.95	91.60
	15	134.00	61.65	40.60		289.75	160.05	93.20
	20	116.40	60.60	40.95		297.35	162.00	93.90
	25	122.55	60.45	40.45		298.65	168.45	93.25
	30	121.00	62.20	39.15		300.35	169.15	92.65
C28	10	102.35	67.60	45.85	**C19**	181.90	95.55	59.65
	15	112.30	69.95	46.10		191.65	96.70	62.00
	20	111.25	69.80	46.70		187.10	97.10	64.75
	25	110.30	71.80	48.75		187.10	101.10	63.75
	30	110.80	72.25	50.35		185.50	102.15	66.50

C10: 100% Carrot, C91: 90% Carrot, 10% Cucumber , C82: 80% Carrot, 20% Cucumber, C73: 70% Carrot, 30% Cucumber, C64: 60% Carrot, 40% Cucumber, C55: 50% Carrot, 50% Cucumber , C46: 40% Carrot, 60% Cucumber, C37: 30% Carrot, 70% Cucumber, C28: 20% Carrot, 80% Cucumber C19: 10% Carrot, 90% Cucumber,C01: 100% Cucumber

cucumber) was significantly low. The scores for flavour reduced with decrease in carrot. Although, there was no significant difference ($p>0.05$) found in sensory scores in samples C91

Table 4: Statistical Parameters of power law model of Honey sweetened Jam produced from Carrot-cucumber blends

Sample	Spindle speed (rpm)	K (mpas)	n	R^2	**Sample**	Spindle speed (rpm)	k	n	R^2
C10	12	414	0.957	0.991	**C91**	12	402	0.915	0.995
	30	131.2	0.909	0.993		30	163.9	0.918	0.991
	60	69.35	0.87	0.985		60	79.96	0.908	0.99
C82	12	252.1	0.779	0.994	**C73**	12	131.1	0.894	0.996
	30	164	0.914	0.991		30	69.99	0.881	0.993
	60	79.97	0.908	0.987		60	52.82	0.908	0.958
C64	12	197.2	0.841	0.997	**C55**	12	218.7	0.908	0.987
	30	160.1	0.956	0.989		30	124.2	0.92	0.988
	60	82.54	0.917	0.991		60	80.69	0.911	0.991
C46	12	139.8	1.032	0.983	**C37**	12	215.8	0.889	0.988
	30	50.23	0.927	0.985		30	104.8	0.845	0.99
	60	181.1	1.569	0.871		60	71.69	0.907	0.993
C28	12	74.54	0.865	0.996	**C19**	12	144.8	0.91	0.995
	30	47.62	0.863	0.991		30	65.8	0.858	0.987
	60	29.85	0.837	0.982		60	39.14	0.832	0.988

C10: 100% Carrot, C91: 90% Carrot, 10% Cucumber , C82: 80% Carrot, 20% Cucumber, C73: 70% Carrot, 30% Cucumber, C64: 60% Carrot, 40% Cucumber, C55: 50% Carrot, 50% Cucumber , C46: 40% Carrot, 60% Cucumber, C37: 30% Carrot, 70% Cucumber, C28: 20% Carrot, 80% Cucumber C19: 10% Carrot, 90% , Cucumber,C01: 100% Cucumber

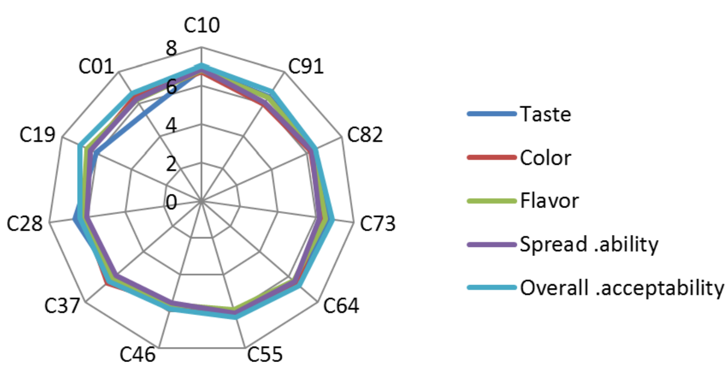

Figure 3: The consumers' responses for Carrot-cucumber jam sweetened with honey

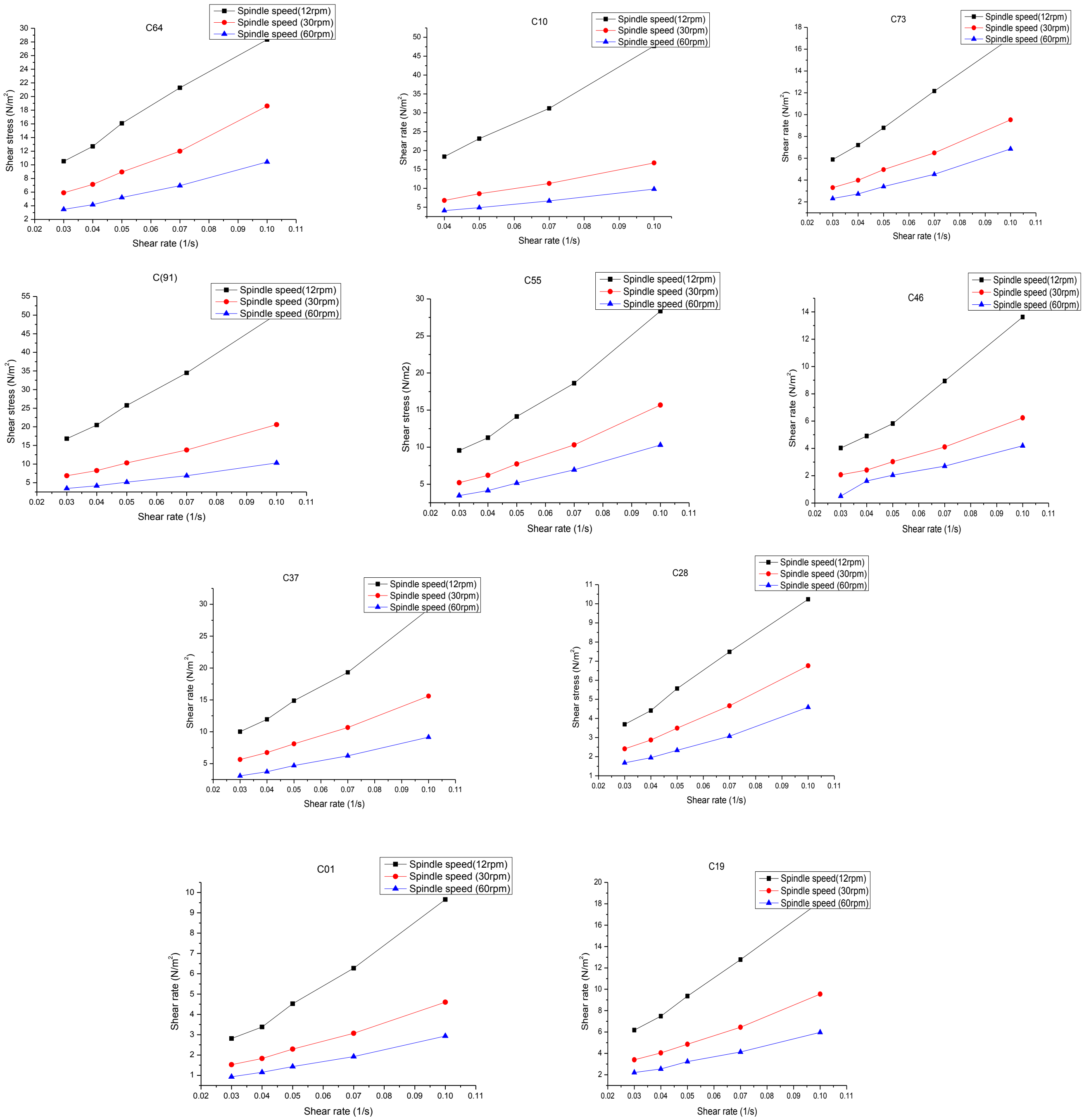

Figure 2: Shear stress-shear rate relationship of Honey sweetened Jam produced from Carrot-cucumber blends

4. Conclusion

The results showed that carrot and cucumber jam produced with honey displayed a pseudo-plastic fluid behavior where the values of n were less than 1 for all the Jam samples. The power law model effectively described the rheological behavior of these products. Sensory results of the composite jam samples indicated the possibility and acceptability of Jam from a combination of different proportions of carrot and cucumber fruits using honey as sweetener. However, the combination with more proportion of carrot is likely to have commercial acceptability.

Conflict of interest

The authors declare that there are not conflicts of interest.

Ethics

This Study does not involve Human or Animal Testing.

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