Improvement The Physicochemical, Sensory and Microbiological Properties of Sweet Sorghum Syrup

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ABSTRACT

The present work was carried out to evaluate four types of sweet sorghum syrup made from Mn 4080 sweet sorghum variety either alone or with one of three herbal extracts (tumeric, cinnamon and ginger) for the physicochemical, sensory and microbiological properties.

The results indicated that sweet sorghum syrup contained cinnamon extract had the highest percentages of sugar profile, tannins, total phenolics, antioxidant activity and minerals (K, Ca and Fe). Moreover, purity and the degree of browning and darkening were increased. Organoleptically, syrup contained cinnamon extract had the highest score in the overall acceptance as compared with the other sorghum syrup types. The results also showed that extracts cinnamon herb played a good role in shelf-life stability during storage period at 25 ± 2°C up to 9 months.

The present work suggests that the cinnamon extracts can be used as an antioxidant and to improve the palatability of sorghum syrup.

Keyword: Sweet sorghum syrup, herbs extract, physicochemical, sensory and microbial counts.

INTRODUCTION

Sugar cane syrup (treacle) is considered as one of the most important food products in Egypt and the international market even though this manufacturing negatively affects sugar production in Egypt because sugar is the main target for sugar cane agriculture. Therefore, total product of sugar cane crop contributes by 75% for sugar manufacturing, 3.2% for treacle productions and 28.2 for fresh juice. Meanwhile, the gap between production and consumption of sugar increases year after year, whereas it arrived at 30.37% according to CCSC (2017). Thus, it was important to change the consumption pattern and look for alternative sources to reduce the gap such as production of syrup from sweet sorghum crop as a substitute for treacle (Khalil *et al.,* 2018).

Sweet sorghum (*Sorghum bicolor* L. Moench) is a good economic crop because it is considered as a multipurpose crop as it produces grains, bagasse, syrup, silage, pasture, and biomass for gasification system for organic fertilizer or paper manufacturing from stem fiber. Almodares & Hadi (2009) stated that sweet sorghum is easily cultivated by seeds, low fertilizer and water requirements. It is cultivated on marginal lands under various environmental stresses, and the growth cycle become short (90 to 130 days) after planting. In contrast to sugar cane, it takes 12-24 months and during cultivation, it costs less. Mohamed *et al.* (2006) studied some chemical and physical parameters of sweet sorghum juice and syrup quality of some varieties. They found that juices contained TSS (19.43–12.37%), sucrose (8.4–17.3%), reducing sugar (1.01–3.20%), and non-sugar substances (5.30 - 6.06%). Meanwhile, Awad-Allah *et al.* (2010) found that sweet sorghum variety contained higher values of TSS%, pH, purity% and titratable acidity for juice and syrup compared to G.T. 54-9 sugar cane variety. Nimbkar *et al.* (2006) showed that sorghum syrup produced from ‘Madhura’ hybrid sweet sorghum cultivar was preferable in colour than cane syrup. Sweet sorghum syrup can be used as a popular food and liquid sweetener in various food products (Elena, 2007). Syrup product finished with dark colour was due to the enzymatic browning reaction when using high temperatures (Sreedevi *et al.,* 2018). Abbas & Ferweez (2006), Awad-Allah *et al.* (2010) and Elkhedir *et al.* (2014) compared the sensory properties of the different syrup from sweet sorghum varieties (Honey,Brandes, Tracy, Williams, Umbrella) and G.T. 54-9 sugar cane variety. Syrup produced from G.T. 54-9 sugar cane variety contained higher values of taste and aroma than syrup of honey sweet sorghum variety. This had a higher score for taste and consistency than varieties of other sweet sorghum syrups. Therefore, sweet sorghum can be considered as a good substitution for saving sugar cane used in syrup production. Herbs have a multivarious role such as food flavorings, preservatives and as medicinal ingredients. Various herbs are documented for their therapeutic properties viz., antioxidative, antihypertensive, anti-inflammatory, antidiabetic, antimicrobial, etc., (Oraon *et al.* (2017). Herbs spices (turmeric, cinnamon and ginger root) are commonly used for flavours, colour, aroma, taste, preservation or anti-bacterial agents, as refreshing and invigorating agents of food (Minghetti *et al.* 2007, El-Ghorab,*et al*. 2010). Microorganisms are one of the main reasons for the alteration syrup of sweet sorghum; they are the primary cause of chemical, physical and sensory deterioration of the syrup because bacterial, moulds and yeasts metabolize carbohydrates into *organic* acids and alcohols (Khare *et al*. 2012). Evaporation of juice is a traditional method to extend shelf life. Thus, microbial counts are a good test to judge food safety and confirm microbiological spoilage (Silva *et al*. 2016).

Therefore, the present work was undertaken to improve the quality and microbiological properties of sweet sorghum syrup. Additionally, to produce safe product with high nutritional value to extend its shelf life in the national and local market.

MATERIALS AND METHODS

Materials:

The present study was carried out at the Agricultural Research Center, Giza, Egypt, to study some technological characters and chemical composition of juice and syrup produced from sweet sorghum variety Mn 4080. The sweet sorghum seeds were sown in May during 2017 season, harvested at the dough stage (about 112 days from sowing date, i.e. seeds were firm and easily crushable by fingers) and treated according to the traditional agricultural practices of the region of Agricultural Research Center, Giza.

Methods:

Herbs extraction and addition:

Three herbs were used as flavours (turmeric, cinnamon and ginger) were purchased from the local market in Cairo, Egypt. Each herb was extracted with pure water and several laboratory experiments were carried out to select the most appropriate treatments. The laboratory experiments showed that the preferable treatment was 1.5 g herb/liter of hot water. After filtration, it was mixed at ratio of 100 ml herbal extract/liter sorghum juice.

Syrup preparation:

Millable stalks were stripped and immediately crushed through 3 roller lab mills then filtrated and clarified juice according to the method described by Gillett.(1960). The clarified juice was heated and evaporated slowly. Concentration was carried out under uniform heating conditions with continuous stirring. During the concentration process frothing occurs as a result of coagulation of any remaining suspended particles resulting in scum. The scum was continuously removed. At the end of this stage, herbal extracts are added. When the final °Brix of concentrated juice (syrup) was 72° to 76°Brix after cooling, heating was completely stopped as described by Nimbkar *et al.* (2006).

Chemical and technological characters of syrups:

Determination of moisture, total solids (TS), total soluble solids (TSS), total sugars , sucrose, reducing sugars , non-sugar substances (NSS), purity, starch, protein, fat, ash, minerals (Fe, K and Ca) and pH values were determined according to methods cited in the AOAC (2010). Titratable acidity was determined according to Chen & Picou (1972) and reported as ml 0.1 N NaOH /100 g of sample and calculated by (mg/m Eq as citric acid) according to Collins *et al.* (1977).The total phenolics content was determined by Folin-Ciocalteau (FC) according to Singleton *et al.* (1965).Antioxidant activity (DPPH) was determined according to the method described by Awika *et al.* (2003).Tannins content was determined according to the method described by Waniska *et al* (1992). Determination of 5-hydroxymethylfurfural (HMF) content in syrup samples was by using HPLC according to Jafarnia *et al*. (2016). Colour of syrup was determined by using Hunter Lab Colorimeter (MiniScan XE Plus,Reston, VA) according to the method described by Hunter (1975) which recorded L* a*b* c* colour system. Hue = tan-1[b / a]; chroma = a2 + b2; X = (a+1.75L) / (5.645L+a -3.012b) browning index = [100(X - 0.31)] / 0.172.

Sensory evaluation: Syrup samples were evaluated according to the method of Larmond., (1977). Panelists were 10 staff members of Sugar Technol., Res. Dept., Sugar Crops Res. Inst., Agric. Res. Center, Giza, Egypt. Four sensory characteristics were evaluated: colour, taste, odour and consistency. The scoring system was 25 points for each character.

Microbiological analysis: Fifty ml of sorghum syrup were sampled at zero, 6 and 9 months after packed and stored under room temperature condition and were submitted to the total counting moulds and yeasts in accordance with the methodology described in APHA (2001).

Statistical analysis:

All data were expressed as mean values. Statistical analysis was performed using one way analysis of variance (ANOVA) followed by Duncans Multiple Range Test with *P* >0.05 being considered statistically significant (Snedecor & Cochran, 1980).

RESULTS AND DISCUSSION

Table (1) shows that the chemical analysis of the different types of pure sweet sorghum syrup or containing herbs extracts of turmeric, cinnamon and ginger were significantly different in all traits under study. The data summarized that sweet sorghum syrup contained cinnamon had the highest percentages of sugar profile such as sucrose and reducing sugars which were very close to that of the total solids. Meanwhile, the results show that sweet sorghum syrup with cinnamon had the highest percentages of tannins, total phenolics and antioxidant activity. Syrup containing cinnamon extract which exhibited 43.99% of DPPH inhibition was not significantly different when compared with containing ginger extracts. There was significant difference in HMF% among the three syrups containing herbs. The collected data also showed that the highest per-

Table 1: Chemical composition of extracted juice and sweet sorghum syrups

Chemical properties	Type of syrup				
	sweet sorghum Juice	sorghum syrup control	Sorghum syrups with herbal extracts		
			Turmeric	Cinnamon	Ginger
Moisture%	83.27±0.022	27.2±0.051	25.40±0.032	25.30±0.045	26.20±0.044
Total Solids%	16.73±0.032	72.2±0.043	72.6±0.053	74.7±0.036	73.8±0.054
Sucrose%	11.12±0.059[a]	33.21± 0.062[c]	32.50±0.065[c]	34.25±0.059[b]	31.22±0.047[d]
Reducing Sugar%	12.80±0.15[d]	22.64±0.18[b]	21.5±0.13[c]	23.75±0.14[a]	21.03±0.17[c]
Total sugars%	13.20±0.036	55.85±0.054	54±0.053	58±0.043	52.25±0.032
Starch%	0.52± 0.033[c]	0.82± 0.024[a]	0.81± 0.034[a]	0.69±0.029[b]	0.80± 0.032[a]
Ash%	0.46±0.11[b]	1.56±0.13[cb]	1.40±0.13b	1.50±0.13[c]	1.40±0.11[b]
Tannins %	0.15± 0.070[d]	30.75± 0.071[b]	22.41±0.074[c]	43.12±0.076[a]	40.03±0.073[a]
*Total phenolics g/100g	246.71± .062[d]	373.00±0.074[c]	443.00±0.074[b]	462.60±0.18[a]	461.75±0.074[a]
Antioxidant activity (% Inhibition)	45.78± .037[a]	35.51±0.039[c]	37.84± 0.034[b]	43.99± .038[a]	41.57± 0.034[a]
HMF %	-	20.05± 0.066[c]	21.20±0.068[b]	22.21± .074[a]	21.03± 0. 062[b]
Mineral contents %					
Fe	0.125±0.18[e]	0.156±0.17[d]	0.158±0.14[c]	0.160±0.15[a]	0.159±0.18[b]
K	0.49±0.13[e]	1.78±0.15[d]	1.80±0.18[b]	1.79±0.19[c]	1.81±0.12[a]
Ca	0.068±0.015[d]	0.178±0.017[c]	0.179±0.014[b]	0.181±0.016[a]	0.179±0.013[b]

*mg gallic acid equivalents (GAE) per 100 g sample.

Mean ±SD value(s) bearing different superscript letter (s) within the same column differ significantly (P≤0.05).

centage contents of iron and calcium were in sweet sorghum syrup contained cinnamon. While the highest value of potassium was in the syrup contained ginger compared to all syrup types samples under study. The variations among chemical properties of sweet sorghum syrups were reported by Akbulut & Özcan (2008), Awad-Allah *et al.* (2010) and Khalil *et al*. (2018).

The results of the above mentioned also are in agreement with our results which indicated that herbals (turmeric, cinnamon and ginger) had high value added for healthy food as obtained by Tapsell *et al.* (2006).

The data in Table (2) show the physical properties of sorghum juice and the different types of syrups. The data cleared that the content of non-sugar substances and titratable acidity were the lowest in syrup containing cinnamon while it showed the highest value for purity over all syrups contained the other herbs.

The data in Table (2) reveal that sorghum syrup containing cinnamon extract had the highest colour values and was significantly different from all the other types of syrup. The colour of sweet sorghum syrup was affected by addition of herbs extracts. It can be noted that the highest values yellowness (b*) appeared in sorghum syrup containing turmeric extract. Sweet sorghum syrup tends to green coordinate (a*) which increased in the control syrup and that contained turmeric and ginger extracts. While, high value of chroma was obtained for the control syrup. Meanwhile, the highest values of the browning index and total colour (ΔE) were recorded in syrup containing cinnamon herb. Thus, the differences in colour intensity of syrup samples might be due to the type and quality of colouring matters in the raw juices.

Moreover, the cooking conditions (time and temperature) may cause Millard and caramelization reactions. This means as well as raising the

Table 2: Physical properties of extracted juice and sweet sorghum syrups

Physical properties	Type of syrup				
	sweet sorghum Juice	sorghum syrup control	Sorghum syrups with herbal extracts		
			Turmeric	Cinnamon	Ginger
TSS%	16.20± .000’	73± 0.000’	73± 0.000’	73±0.000’	73± 0.000’
pH	5.4±0.028^{b}	5.5±0.074^{b}	5.6± 0.034^{a}	5.7±0.038^{a}	5.7± 0.074a
Titratable acidity**	31.4± 0.074^{c}	36.71±0.058^{b}	40.50±0.079^{a}	37.41±0.031^{b}	39.22±0.049^{a}
Purity%	60.65±0.11^{a}	45.49±0.14^{c}	44.52±0.17^{d}	46.91±0.13^{b}	42.76±0.19^{e}
NSS%	12.80±0.16^{d}	15.81±0.18^{c}	18.15±0.13^{b}	15.00±0.11^{c}	20.75±0.19^{a}
Viscosity	-	2560± 0.024^{c}	2570± 0.034^{b}	2570±0.029^{b}	2578± 0.032^{a}

Mean ±SD value(s) bearing different superscript letter(s) within the same column differ significantly (P≤0.05).

** as a citric acid mg/m Eq

Table 3: Colour evaluation of sweet sorghum syrups

Colour Parameters	Type of syrup			
	Sweet sorghum syrup (control)	Sorghum syrup with herb extracts		
		Turmeric	Cinnamon	Ginger
L*	6.81±0.03d	4.16±0.08e	9.74±0.05b	8.64±0.04c
a*	-0.45±0.03c	-3.17±0.06a	0.89±0.08b	-0.18±0.02d
b*	2.85±0.03c	5.04±0.06a	0.57±0.04e	1.45±0.05d
Hue	58.87±0.03e	73.39±0.06a	71.57±0.02b	67.57±0.08d
Chroma	2.89±0.06a	0.81±0.08d	1.94±0.03c	1.76±0.05c
Browning index	6.65±0.03e	7.41±0.03d	11.09±0.03b	9.57±0.03c
Final color (ΔE)	6.30±0.14d	6.56±0.15d	8.56±0.13b	7.56±0.11c

L (lightness with L = 100 for lightness, and L = zero for darkness), a [(chromaticity on a green (-) to red (+)], b [(chromaticity on a blue (-) to yellow (+)]. Mean ±SD value(s) bearing different superscript letter(s) within the same column differ significantly (P≤0.05).

HMF value by non-enzymatic browning, lead to an increase in reducing sugar contents in sorghum syrups then enhancing the rate of browning reaction. These results are close to that obtained by Akbulut & Özcan (2008) and Khalil *et al.* (2018).

Sensory evaluation of sorghum syrup and those contained extracts of turmeric, cinnamon and ginger are demonstrated in Table (4). The data indicated that the addition of cinnamon extract clearly enhanced taste, consistency and overall acceptability as compared with the other extracts and the control. These results indicate that addition of cinnamon to sorghum syrup improved most of the sensory attributes. Meanwhile, this greatly affected the acceptability of using sorghum syrup instead of sugar cane syrup. These results may be due to the characteristics of strong spicy-sweet, flavour and aroma of cinnamon (Brewer, 2011). Further, syrup with ginger extract had the lowest score in the overall acceptability. These data are in harmony with those of Elena, (2007**)** who revealed that the total score of sensory evaluation of sweet sorghum syrup was closed to the sugar cane syrup, therefore sweet sorghum can be suitable for syrup production.

As shown in Table (5) moulds, yeast and bacteria were not detected at zero time of storage in any type of syrup samples. The microbial counts started to appear after storing syrup samples to 6 and 9 months. The results demonstrated that microbial counts increased with extension the storage period. The population of bacteria, fungi and yeasts were low in

Table 4: Sensory evaluation of sweet sorghum syrups

Laboratory Characters Score (25)	Type of syrup			
	Sorghum syrup (control)	Sorghum syrup with herb extracts		
		Turmeric	Cinnamon	Ginger
Taste	19.00±0. 11 d'	20.25±0. 18 b'	24.00 ±0. 18 a'	12.30±0. 18 c'
Consistency	18.50 ±0. 14 d'	18.35±0. 11 d'	23.30 ±0. 15 a'	16.50 ±0. 14 c'
Aroma	17.50 ±0. 17 d'	16.50 ±0. 14 b'	23.00 ±0. 13 a'	14.25±0. 11 c'
Preference	19.00 ±0. 13 c'	19.00±0. 15 c'	23.50 ±0. 15 a'	15.25±0. 15 b'
Overall acceptability (100)	75.00 ±0. 15 c'	76.00±0. 11 c'	93.80 ±0. 14 a'	58.30 ±0. 13 b'

Mean ±SD value(s) bearing different superscript letter(s) within the same column differ significantly (P≤0.05).

Table 5: Effect of storage period at 25 ± 2°C on the population of microorganisms in sweet sorghum syrups samples

Constant%	Type of syrup			
	sorghum Syrup (control)	Sorghum syrup with herb extracts		
		Turmeric	Cinnamon	Ginger
	Zero time			
Mold	0.00± 0.000”	0.00± 0.000”	0.00± 0.000”	0.00± 0.000”
Yeast	0.00± 0.000”	0.00± 0.000”	0.00± 0.000”	0.00± 0.000”
Bacteria	0.00± 0.000”	0.00± 0.000”	0.00± 0.000”	0.00± 0.000”
	After six month			
Mold	0.15± 0.001^{b}	0.09± 0.002^{d}	0.11±0.001^{c}	0.09± 0.002$^{d'}$
Yeast	0.21± 0.008^{b}	0.15± 0.006^{d}	0.18± 0.008$^{c'}$	0.17± 0.002$^{c'}$
Bacteria	0.19± 0.001$^{a'}$	0.12± 0.001$^{b'}$	0.09± 0.004$^{d'}$	0.11± 0.001$^{c'}$
	After nine month			
Mold	0.20± 0.008^{b}	0.17± 0.006^{c}	0.19± 0.006^{d}	0.20± 0.008$^{c'}$
Yeast	0.36± 0.002^{a}	0.21± 0.006^{d}	0.23± 0.008 ^{c}	0.20± 0.002$^{e'}$
Bacteria	0.34± 0.002$^{a'}$	0.21± 0.001$^{c''}$	0.18± 0.002$^{d'}$	0.22± 0.001$^{b'}$

Mean of mold yeast and bacteria colonies count /type of syrup samples less than 25 ± 2° C
Mean ±SD value(s) bearing different superscript letter(s) within the same column differ significantly (P≤0.05).

samples of sweet sorghum syrups containing all herb extracts under study compared with the control syrup. These results may confirm that the addition of herbal extracts have a preservative function and coloring. Moreover, syrup contained cinnamon extract had the lowest microbial counts comparing with the other herbal extracts. These results are in agreement with these reported by Oraon *et al.* (2017**)** who found that turmeric and cinnamon can improve the deliciousness, aesthetic appeal and shelf life of delicate food products**.** The extracted turmeric is expensively used as preservative and colouring agents. It has been used as traditional medicine in order to prevent several diseases Chattopadhyay *et al.* (2004). Also Brewer, (2011) found that cinnamon had the highest antimicrobial effect followed by ginger and turmeric. Concerning the positive effect of cinnamon, these results may be due to its characteristics which related to the advantage of being an antioxidant material such as phenolic acids, terpenes, and tannins (Dugoua *et al.* 2006, Elena, 2007).

The results of physicochemical properties of syrup samples during storage period from zero to up 9 months are presented in Table 6. It could be noted that the Brix, titratable acidity, moisture, protein, fat, ash and total sugars content were significantly affected by the different storage period at 25 ± 2°C. The results of physicochemical changes during storage period from zero to up 9 months demonstrate

Table 6: Effect of storage period at 25 ± 2°C on physicochemical properties of sweet sorghum syrups

Constant%	Type of syrup			
	sorghum syrup	Sorghum syrup with herb extracts		
	(control)	Turmeric	Cinnamon	Ginger
Brix %	73.20±0.14^{d}	75.20±0.16^{b}	74.20±0.13^{c}	75.20±0.17^{a}
Titratable acidity**	0.462±0.13^{b}	0.455±0.18^{c}	0.443±0.15^{d}	0.491±0.14^{a}
Moisture %	27.2±0.16^{a}	27.4±0.14^{a}	27.3±0.18^{a}	27.2±0.12^{a}
T. nitrogen %	0.43±0.12^{c}	0.46±0.13^{b}	0.45±0.15^{a}	0.47±0.11^{a}
Fat %	0.52±0.18^{a}	0.56±0.17^{a}	0.62±0.11^{a}	0.60±0.13^{a}
Ash %	1.56±0.11^{b}	1.40±0.13^{cb}	1.50±0.13^{b}	1.40±0.13^{c}
Total sugar %	55.85±0.13^{b}	54±0.17^{c}	58±0.14^{a}	52.25±0.18^{d}
	After six month			
Brix %	75.34±0.14^{d}	76.13±0.16^{b}	75.24±0.13^{c}	76.23±0.17^{a}
Titratable acidity**	0.792±0.13^{a}	0.558±0.18^{c}	0.541±0.15^{d}	0.583±0.14^{b}
Moisture %	25.5±0.16^{a}	26.2±0.14^{a}	26.5±0.18^{a}	26.3±0.12^{a}
T. nitrogen %	0.50±0.12^{c}	0.57±0.13^{b}	0.46±0.15^{a}	0.50±0.11^{a}
Fat %	0.55±0.18^{a}	0.57±0.17^{c}	0.65±0.11^{c}	0.61±0.13^{d}
Ash %	1.58±0.11^{A}	1.05±0.17 ^{b}	1.03±0.15 ^{cb}	1.45±0.12^{bc}
Total sugar %	5٣.80±0.15^{b}	56.80±0.17^{c}	59.04±0.14^{a}	53.50±0.18^{d}
	After nine month			
Brix %	73.54±0.14^{d}	76.75±0.16^{b}	75.71±0.13^{c}	76.43±0.17^{a}
Titratable acidity**	0.984±0.13^{a}	0.560±0.18^{c}	0.551±0.15^{d}	0.591±0.14^{b}
Moisture %	24.5±0.12^{c}	25.5±0.13^{b}	26.1±0.14^{a}	25.2±0.11^{b}
T. nitrogen %	4.70±0.12^{c}	0.60±0.13^{b}	0.48±0.15^{a}	0. 48±0.11^{a}
Fat (%)	0.58±0.18^{a}	0.58±0.17^{c}	0.66±0.11^{c}	0.46±0.13^{d}
Ash (%)	1.60±0.11^{A}	1.47±0.14 ^{b}	1.67±0.18 ^{cb}	1.66±0.15^{bc}
Total sugar (%)	52.45±0.12^{d}	57.71±0.19^{b}	60.52±0.11^{a}	54.42±0.14^{c}

*TA: as ml Na OH 0.1 N/ 100 g sample and calculated by (mg/m Eq as a citric acid)
Mean ±SD value(s) bearing different superscript letter(s) within the same column differ significantly ($P \leq 0.05$).

that herb extract plays a good role in shelf-life stability after storage periods because the flavouring additive were slightly raised the acidity as well as the total sugars as compared to the control syrup.

The shelf-life stability of syrups may be related in general to ambit growth of microbial load during storage (Silva *et al*., 2016), which requires the availability of some factors like moisture and suitable pH thus., water activity and titratable acidity are considered the main factors that affect the shelf-life stability of syrups (Khare *et al*., 2012).

CONCLUSION

In the light of physicochemical, sensory evaluation and microbial counts during storage periods for sweet sorghum syrup (control) or containing herbs extracts of (turmeric, cinnamon and ginger), it could be concluded that sweet sorghum is a good source of syrup production and it can be an attractive marketable product with different herbal flavours for all people who need to raise a beneficial health while consuming as well as for length shelf-life stability.

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تحسين الخواص الفيزيوكيميائية والحسية والميكروبيولوجية لشراب الذرة السكرية

سها رمضان ابوالعلا خليل ، سمر عبد العاطى محمد حلمى ، أنور حامد ساسى بربرى

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أجري هذا البحث لتقييم أربعة أنواع من شراب الذرة الرفيعة المصنوعة من صنف Mn ٤٠٨٠ إما بمفرده أو مع واحد من ثلاثة أنواع عشبية (الكركم ، القرفة، الزنجبيل) وذلك من حيث الخصائص الفيزيائية والكيميائية والحسية والميكروبيولوجية مقارنة بشراب الذرة الرفيعة السكرية بمفرده .

أظهرت النتائج أن الخصائص الكيميائية والفيزيائية لانواع الاشربة ان شراب الذرة السكرية بنكهة القرفة يحتوي على أعلى النسب من السكريات المختزلة والفينولات الكلية والتانينات لقيم نشاط مضادات الاكسدة ومحتواها من هيدروكسى ميثايل فورفيورال . وأشارت نتائج التقييم اللونى لأنواع الأشربة إلى أن درجة اللون البنى والاغمقاق زادت مع شراب الذرة بنكهة القرفة تلاه نكهة الزنجبيل تم شراب الذرة بنكهة الكركم وجاء فى الترتيب الاخير شراب الذرة بدون نكهة . خلصت نتائج تجربة التذوق الحسى الى وجود فروق معنوية بين شراب الذرة بدون اضافة نكهة او باضافة مستخلص نكهات الاعشاب. و أوضح التقييم ان شراب الذرة الرفيعة السكرية بنكهة القرفة احرز اعلى القيم مقارنة مع أنواع أشربة الذرة السكرية الأخرى.

وأظهرت النتائج أيضًا أن مستخلصات عشبة القرفة لعبت دورًا جيدًا في إطالة فترة التخزين عند ٢٥ درجة مئوية إلى ٩ أشهر وبالتالي يشير هذا البحث إلى أنه يمكن استخدام مستخلصات القرفة كمضاد للأكسدة، ولتحسين استساغة شراب الذرة الرفيعة السكرية.