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Characteristics of three banana cultivars for specific product requirements

(Ciri-ciri tiga kultivar pisang untuk keperluan hasilan khusus)

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Key words: characteristics, jam, confectionery jelly, powder, premixes

Abstrak

Tiga kultivar pisang iaitu Mas, Tanduk dan Berangan telah diperoleh dan diproses mengikut kaedah pemprosesan yang diwujudkan di MARDI menjadi hasilan jam, jeli, serbuk dan campuran segera (kv. Mas), kerepek pisang masin (kv. Tanduk) dan kerepek pisang bersira (kv. Berangan). Analisis kimia dijalankan terhadap pisang segar dan hasilannya. Hasil yang diperoleh disimpan dalam pangkalan data untuk digunakan sebagai garis panduan bagi tentuan pisang segar dan hasilannya.

Abstract

Three banana cultivars, namely Mas, Tanduk and Berangan, were obtained and processed according to standard processing methods established by MARDI into jam, jelly, powder and premixes (cv. Mas), salted banana chips (cv. Tanduk) and glazed banana chips (cv. Berangan). Chemical analysis of the raw banana and their products were carried out and the results stored in database as guideline characteristics for specifications of banana and its products.

Introduction

In the national policy of the Sixth Malaysia Plan (RM6), a complete package technology concept is required in the development and advancement of the agricultural and food industries. Thus, research in the agricultural sector must also include downstream activities such as postharvest technology in handling, grading and storage; use of agricultural resources to be processed into various products as well as quality specifications for both produce and products. It is necessary to establish specifications for agricultural raw materials intended for specific end uses and to control the desired quality of the final products in accordance with good manufacturing practices.

Banana (*Musa* sp.), one of the important fruits in Malaysia, ranked second in terms of production volume accounting for 56 960 t/year after durian (118 438 t/year) (Anon. 1983a). Large-scale production as an intercrop has been introduced by the Federal Land Consolidation and Rehabilitation Authority (Felcra) to maximize land use and to develop its export potential by making available a consistent supply of good quality fruit. The popular local dessert cultivars are Mas, Embun, Rastali and Berangan. The cooking types are Tanduk, Raja, Nangka, Awak and Abu (Abdullah et al. 1990)

Research data on various aspects and types of banana and its products are often not very comprehensive or not available.

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Those available are for the fresh bananas cv. Mas, Tanduk and Berangan (Abdul Shukor 1988; Mat Isa 1988; Tee et al. 1988), banana chips (Soriano et al. 1976; Rasit and Augustin 1982; Zaidah et al. 1985; Khatijah 1986) and banana powder (Patil and Magar 1976; Ukhun and Ukpebor 1991). In this paper, the properties of banana cultivars cv. Mas, Tanduk and Berangan as well as their products (banana jam, confectionery jelly, powder, premixes and chips) are looked into.

Materials and methods

Acquisition of samples

All the samples analysed, i.e. fruit types and their degree of ripeness as well as their various processed products, were acquired according to recommendations and the standard methods of processing established through research in MARDI. Three lots of each sample were obtained over the year to consider seasonal variations. Analyses were carried out in triplicates on fresh bananas as well as their products.

Mas banana

Banana bunches of colour ripeness index 6–7 (Lizada et al. 1990) were purchased from local markets. Fruit were dehanded, steamed, skinned and pureed in a bowl chopper (Zainun and Foo 1989; Zainun 1992a) and processed into jam, confectionery jelly, powder and premixes.

Jam was prepared according to the standard formulation of MARDI (Anon. 1987). The puree was processed into jam of 35% fruit content with the addition of sugar, water, pectin, citric acid and colouring (Anon. 1987; Zainun and Foo 1989; Zainun 1992a, b).

Confectionery jelly was prepared in accordance to the standard MARDI formulation (Anon. 1991). The puree was mixed with a solution of pectin, sodium citrate and sugar, and boiled for 1 min (Sharifah, S., MARDI, Serdang, pers. com. 1991). Glucose syrup and sugar were then added and the solution boiled to 108 °C when the soluble solids content reached 78 °Brix. Acid and flavouring were mixed in and the hot solution poured into prepared cornflour moulds to set for 12–24 h. Upon removal from the moulds, the jelly was steamed lightly to wet the surface and then dredged in castor sugar and wrapped (Anon. 1991; Sharifah, S., MARDI, Serdang, pers. com. 1991).

Banana powder was prepared following the standard MARDI formulation (Zainun 1992a; Zainun and Zainun 1992). The puree was homogenized through a colloid mill and then dried in a double drum dryer, followed by a cabinet dryer at 60 °C for 12–15 h to a moisture content of less than 10%. The dried flakes were then frozen for 20 min. An anti-caking agent was mixed in before sieving to produce banana powder (Zainun and Foo 1989; Zainun 1992a; Zainun and Zainun 1992).

The premixes were prepared according to the standard MARDI formulations (Faridah 1987, 1988) by combining together banana powder, wheat flour, sugar, conditioner, milk powder and salt (banana cake premix), and banana powder, wheat flour and conditioner (*jemput-jemput* premix).

Tanduk banana

For the production of salted banana chips, mature green bananas of 6–7 weeks old (i.e. from first appearance of the flower stalk) were harvested. Fruit were peeled, sliced into thin cross-sectional chips directly into hot oil at 190 °C and fried for 5 min before lifting and tossing. The chips were left to drain and then salted (Anon. 1983b; Sharipah, N., MARDI, Serdang, pers. com. 1983).

Berangan bananas

For the production of glazed banana chips, mature green bananas were harvested at 11–13 weeks old when the colour changed from light green (Abdullah 1983). Fruit were peeled, sliced into thin longitudinal chips into oil and allowed to soak for 5 min. The slices were then fried in hot oil at 150 °C for 10 min, lifted off and soaked in 60 °Brix

syrup for 10 min. This was followed by alternately frying for 2 min and soaking in syrup for 5 min. This process was repeated twice before final frying for 2 min (Zaidah et al. 1985; Anon. 1989).

Analysis

The different banana cultivars and their products were analysed using standard methods of analysis on homogenized and blended samples.

The pH was measured using a Corning pH meter Model 7. The total soluble solids was determined using hand refractometers (Atago N3) with range of 0–50 and 58–90% (Brix) while the total sugars/reducing sugars were determined by spectrophotometric measurement using 3, 5 dinitrosalicylic acid (DNS) reagent before and after inversion process (Sumner 1925). The total titratable acidity was determined by titration with 0.1 *N* NaOH with phenolphtalein as indicator. The results were expressed in terms of the major acid present in the raw material (Pearson 1976). Metal contaminants were determined on the ash of samples by Inductive Coupled Plasma Atomic Emission Spectrometer (ICP-AES), ARL Optical Emission Model 3560 (Switzerland). Microbiological tests were carried out for total plate counts and presence of yeasts, moulds and osmophiles (Speck 1976).

Proximate analysis was carried out using standard methods by Pearson (1976). Moisture was determined by oven method at 103 ± 2 °C. Fat was determined by soxhlet extraction with petroleum ether (bp 40–60 °C) for 16 h. Ash was obtained by heating in a muffle furnace at 540 ± 1 °C for 5 h. The ash was retained for analysis of copper, iron and zinc. Protein analysis was carried out by the Kjeldhal method for nitrogen. The protein content was obtained by multiplying the nitrogen content by a factor of 5.95. Crude fibre was determined by extraction with petroleum ether. The extract was digested with sulphuric acid, and the insoluble matter filtered, washed, dried and weighed as crude fibre. Carbohydrate by difference was calculated as 100 – (%moisture + %fat + %ash + %protein + %crude fibre).

Hunterlab colour was determined by direct reading with a Minolta chroma meter CR 200. Gel strength was determined using a Sommner and Runge KG – SUR PNR6 penetrometer with a straight-hole disc plunger (16 holes) of weight 28 g. Gel strength (in grams per centimetre square) was taken as the weight used just before a break in the jam occurred. Pectin was determined as calcium pectinate (Pearson 1976). Water activity was determined on a Rotronic-Hygroskop meter, room temperature being recorded as the temperature of measurement.

Results and discussion

Results of the analysis showing the range of values and means for the various parameters recorded for fresh bananas and their products are given in *Table 1* to *Table 4*.

From the data obtained, it can be seen that fresh bananas were high in moisture content (63–71%) while their products could be divided into intermediate moisture products as in jam (18–26%), low moisture products for example confectionery jelly, powder and premixes (6–9%), and dry products such as chips with the lowest moisture contents (2–4%).

Sugar level was high in Mas banana (16–21%) but lower in Berangan and Tanduk (1–2%) since the ripe Mas banana fruit were used while green Berangan and Tanduk were used. Products with sugar added such as jam and jelly (63–68% and 59–66% respectively), glazed banana chips (21–31%) and cake premix (16–17%) obviously showed high sugar contents depending on the amount of sugar added in the formulations. For those products with no sugar added, their sugar contents reflected only that initially present in the source materials as observed for *jemput-jemput* premix (9–12%) and salted banana chips (1–2%).

Table 1. Guideline specifications data of Mas banana, jam and confectionery jelly

	Mas banana			Jam			Confectionery jelly		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
pH	4.8–5.1	4.9	0.14	3.3–3.4	3.4	0.04	3.7–4.0	3.8	0.12
Total soluble solids (°Brix)	28–31	29.2	1.31	67–69	67.8	0.86	67–84	78.0	7.79
Total titratable acidity (% as maleic acid)	0.25–0.43	0.35	0.07	0.63–0.76	0.71	0.06	0.33–0.37	0.35	0.12
Total sugars (%)	15.80–20.50	18.35	1.94	63.19–68.14	65.44	2.04	58.55–66.41	63.43	3.48
Reducing sugars (%)	9.36–9.76	9.54	0.17	33.82–35.85	34.94	0.84	15.96–18.66	17.33	1.10
Pectin (%)	0.46–0.52	0.50	0.03	0.47–0.58	0.53	0.04	1.13–1.20	1.16	0.03
Proximate analysis									
Moisture (%)	70.95–71.46	71.13	0.24	18.46–25.64	23.08	3.27	7.04–8.75	7.91	0.70
Fat (%)	0.19–0.68	0.39	0.21	0.10–0.66	0.34	0.23	0.05–0.17	0.11	0.05
Protein (%)	1.04–1.21	1.16	0.08	0.56–0.62	0.59	0.03	2.14–3.33	2.91	0.58
Crude fibre (%)	0.95–1.03	0.98	0.04	0.16–0.27	0.20	0.05	0.20–0.22	0.21	0.01
Ash (%)	0.84–1.56	1.09	0.33	0.36–0.49	0.44	0.06	0.40–0.48	0.44	0.03
CHO by difference (%)	24.07–25.97	25.20	0.82	72.56–79.99	75.32	3.32	87.09–89.84	88.27	1.16
Insoluble solids (%)	4.24–5.27	4.70	0.43	1.71–2.27	1.94	0.24			
Metal contaminant									
Cu (mg/100 g)	0.37–0.34	0.36	0.01	0.07–0.07	0.07	0	0.07–0.45	0.20	0.18
Fe (mg/100 g)	0.45–0.50	0.48	0.03	0.30–0.75	0.53	0.23	0.45–0.80	0.60	0.15
Zn (mg/100 g)	0.43–0.51	0.47	0.04	0.22–0.40	0.31	0.09	0.19–0.20	0.20	0
Microbial analysis									
Total plate count				nd to 1.6 x 10^2			nd		
Moulds and yeasts				nd to 1.0 x 10^2			nd		
Osmophiles				nd			nd		
Gel strength (g/cm^2)				22.9–27.4	25.3	1.84			
Colour *L*				+36.8 to + 40.2	+38.1	1.48	+59.8 to +62.8	+61.1	1.23
a				+3.2 to + 4.3	+3.9	0.50	–1.8 to –1.4	–1.6	0.16
b				+12.9 to + 21.8	+18.7	4.06	+27.8 to +29.7	+28.5	0.86
Water activity at 24.3 °C							0.68–0.71	0.69	0.01

Table 2. Guideline specifications data of banana powder, premix for cake and *jemput-jemput*

	Powder			Cake premix			*Jemput-jemput* premix		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
pH	3.2–3.2	3.2	0	5.7–6.0	5.8	0.11	5.3–6.3	5.7	0.42
Total titratable acidity (% as maleic acid)	1.73–1.80	1.76	0.03	0.67–0.74	0.69	0.03	0.23–0.35	0.29	0.05
Total sugars (%)	19.66–19.98	19.85	0.14	15.84–16.79	16.22	0.41	8.76–12.10	10.32	1.68
Reducing sugars (%)	10.25–10.58	10.41	0.14				8.76–12.10	10.32	1.37
Proximate analysis									
Moisture (%)	5.89–6.95	6.47	0.44	5.63–6.83	6.14	0.51	6.20–6.75	6.53	0.24
Fat (%)	0.16–0.21	0.19	0.02	1.97–2.03	2.00	0.02	1.32–1.54	1.41	0.09
Protein (%)	6.44–6.65	6.58	0.10	5.75–5.90	5.82	0.06	10.39–10.57	10.45	0.09
Ash (%)	3.68–3.98	3.87	0.13	1.24–1.34	1.28	0.04	1.80–1.86	1.83	0.02

Fat content was generally low in banana and its products (0.1–0.7%) except in the cases of banana chips which are deep-fat fried and therefore high in fat content (15–40%). Addition of other ingredients in premixes also resulted in a slight increase (1–2%) due to fat contribution from these added ingredients.

Microbial counts were not detectable or negligible, and total metal content (Cu, Fe and Zn) were present at low levels (0.71–1.45 mg/100 g) within acceptable ranges.

Comparisons of data from this study with available data for the raw banana cultivars and their products are shown in *Table 5* to *Table 7*. It is noted in *Table 5* that proximate analysis data, total titratable acidity and total sugars for raw banana cultivars were similar to those reported by Abdul Shukor (1988), Mat Isa (1988) and Tee et al. (1988). However, data available for some products differed as these products were from different starting materials and processing conditions.

It is noted that the fat content of banana chips differed from those obtained by Rasit and Augustin (1982), and Khatijah (1986) but similar to that by Soriano et al. (1976) in spite of the different raw materials used by the latter *(Table 6)*. However, both the fat and moisture contents of glazed banana chips differed from those of the latter but similar to those obtained by Zaidah et al. (1985).

For banana powder *(Table 7)*, results obtained were quite similar to those reported by Zainun and Zainun (1992) except for a slightly lower pH of 3.2 compared with 4.6 by the latter. This can be expected as the processing method and parameters were similar. On the other hand, the moisture contents differed from those of Patil and Magar (1976) as well as Ukhun and Ukpebor (1991) due to different drying methods employed. Differences in pH, total sugars, fat, protein and ash contents may be attributed to the different cultivars used, namely Basrai and Rajeli by the former and *Musa paradisiaca* by the latter workers.

Table 3. Guideline specifications data for Tanduk banana and salted banana chips

	Tanduk			Salted banana chips		
	Range	Mean	SD	Range	Mean	SD
pH	4.5–6.7	5.7	0.91	5.5–5.8	5.6	0.12
Total titratable acidity (% as maleic acid)	0.17–0.30	0.22	0.06	0.24–0.28	0.27	0.02
Total sugars (%)	1.22–1.26	1.24	0.02	1.43–2.02	1.67	0.25
Reducing sugars (%)	0.21–0.27	0.23	0.03	0.50–0.64	0.56	0.06
Proximate analysis						
Moisture (%)	66.22–69.23	67.46	1.28	1.95–3.74	2.67	0.77
Fat (%)	0.06–0.39	0.23	0.13	33.78–40.39	37.05	2.70
Protein (%)	1.30–1.50	1.40	0.09	2.81–2.92	2.86	0.05
Crude fibre (%)	0.95–1.05	0.99	0.04	1.01–1.37	1.22	0.15
Ash (%)	0.98–1.40	1.17	0.17	2.18–2.95	2.49	0.33
CHO by difference (%)	26.68–30.09	28.66	1.45	51.16–56.61	53.56	2.27
Metal contaminant						
Cu (mg/100 g)	0.11–0.12	0.12	0	0.26–3.29	1.78	1.52
Fe (mg/100 g)	0.50–0.89	0.70	0.19	0.75–1.09	0.92	0.17
Zn (mg/100 g)	0.35–0.40	0.38	0.02	0.39–0.64	0.52	0.12
Water activity at 23.1 °C				0.12–0.54	0.33	0.17
PV (meq/kg)				0.5–14.0	8.7	5.89

Table 4. Guideline specifications data for Berangan banana and glazed banana chips

	Berangan			Glazed banana chips		
	Range	Mean	SD	Range	Mean	SD
pH	4.1–5.9	4.8	0.81	5.3–5.4	5.3	0.04
Total titratable acidity (% as maleic acid)	0.24–0.60	0.47	0.17	0.27–0.37	0.33	0.04
Total sugars (%)	2.24–2.29	2.27	0.02	21.16–31.18	26.39	4.10
Reducing sugars (%)	0.20–0.23	0.21	0.01	1.93–3.04	2.63	0.50
Proximate analysis						
Moisture (%)	63.35–70.89	67.99	3.31	1.95–4.46	3.01	1.06
Fat (%)	0.05–0.38	0.23	0.14	15.23–19.13	17.40	1.62
Protein (%)	1.21–1.24	1.22	0.02	2.02–2.20	2.08	0.09
Crude fibre (%)	0.81–0.90	0.85	0.04	0.49–0.55	0.53	0.03
Ash (%)	0.99–1.05	1.02	0.02	1.11–1.79	1.44	0.28
CHO by difference (%)	25.69–33.11	28.62	3.22	73.79–76.40	75.44	1.17
Metal contaminant						
Cu (mg/100 g)	0.10–0.10	0.10	0	0.20–0.20	0.20	0
Fe (mg/100 g)	0.45–0.86	0.66	0.21	0.70–0.93	0.82	0.12
Zn (mg/100 g)	0.29–0.32	0.31	0.02	0.52–0.64	0.58	0.60
Water activity at 22.8 °C				0.21–0.48	0.30	0.13
PV (meq/kg)				0.5–11.8	7.2	4.88

Conclusion

Chemical characteristics of three banana culitvars and their products have been determined. They may be used as guideline characteristics for the establishment of specifications for these materials. However, it should be pointed out that the data obtained in this study may be applied for specifications of products derived only from the standard MARDI processes and may be different if other processes and raw materials are used.

Table 5. Data for Mas, Tanduk and Berangan bananas from various sources

	Mas				Tanduk		Berangan	
	S1	S2	S3	S4	S1	S4	S1	S4
pH	4.9		4.9					
Total soluble solids (°Brix)	29.2	22.0	27.5					
Total titratable acidity (% as maleic acid)	0.35	0.39						
Total sugars (%)	18.35	15.47						
Moisture (%)	71.13			73.0	67.46	69.5	67.99	73.1
Fat (%)	0.39			0.3	0.23	0.4	0.23	0.3
Protein (%)	1.16			1.4	1.40	1.2	1.22	1.0
Crude fibre (%)	0.98			1.7	0.99	0.5	0.85	1.0
Ash (%)	1.09			0.7	1.17	0.8	1.02	0.9
CHO by difference (%)	25.20			22.9	28.66	27.6	28.62	24.2

S1 = this study
S2 = Abdul Shukor (1988)
S3 = Mat Isa (1988)
S4 = Tee et al. (1988)

Table 6. Data for salted and glazed banana chips from various sources

	Salted chips				Glazed chips		
	S1	S2	S3	S4	S1	S4	S5
Moisture (%)	2.67	3.2	2.5	1.5	3.01	1.5	3.8
Fat (%)	37.05	14.0	17.5	38.6	17.40	31.5	19.9
Protein (%)	2.86	1.7					
Crude fibre (%)	1.22	1.5					
Ash (%)	2.49	1.0					
CHO by difference (%)	53.55	78.6					
PV(meq/kg)	8.7	4.7					

S1 = this study
S2 = Khatijah (1986)
S3 = Rasit and Augustin (1982)
S4 = Soriano et al. (1976)
S5 = Zaidah et al. (1985)

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Table 7. Data for banana powder and jam from various sources

	Banana powder					Banana jam	
	S1	S2 (vac. oven dry)	S2 (spray dry)	S3	S4	S1	S5
pH	3.2			6.6	4.6	3.4	3.6
Total soluble solids (°Brix)						67.8	69.5
Total titratable acidity (% as maleic acid)	1.76				1.95	0.71	0.71
Total sugars (%)	19.9	81.81	78.93	30.1	19.9		
Moisture (%)	6.47	1.50	3.43	0.6	6.50	23.08	28.55
Fat (%)	0.19	0.56	0.56		0.19		
Protein (%)	6.58	2.52	2.55		6.91		
Ash (%)	3.87	2.46	2.74		3.87		

S1 = this study
S2 = Patil and Magar (1976)
S3 = Ukhun and Ukpebor (1991)
S4 = Zainun and Zainun (1992)
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