Sompoton: Sabah Bamboo Mouth Organ

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This study considered the Sabah traditional bamboo musical instrument, sompoton. The fast Fourier transform (FFT) of sompoton was determined *via* a Pico oscilloscope. All three sompotons displayed almost similar fundamental frequencies. The individual tubes 1, 2, 3, 4, 5, 6, and 8 (except tube 7) of sompoton I, II, and III produced the fundamental frequency (in hertz) as 924, 758, 655, 589, 449, 407, 537, as 954, 779, 655, 614, 469, 387, 552, and as 944, 820, 655, 635, 407, 407, and 552, respectively. The averaged frequency obtained from the three sompotons (with the diatonic frequency and note in bracket) was 940.6 (932.3-A5# tube 1), 785.6 (783.9-G5 tube 2), 655 (659.2-E5 tube 3), 612.6 (622.2-D5# tube 4), 547 (554.3-C5# tube 8), 441.6 (440-A4 tube 5), and 400.3 (392-G4 tube 6). The tunings were remarkably similar in the tonal relationships. The pitch of the drone tube (tube 6) repeated an octave higher at tube 2, the intervals of perfect 4th higher at tube 8, and the intervals of perfect 5th higher at tube 4 were always found. The standard deviations of the fundamental pitch from the three sompotons for tube 1, 2, 3, 4, 5, 6, and 8 were 15.3, 31.5, 0.0, 9.2, 31.6, 11.5, and 8.7, respectively.

DOI: 10.15376/biores.17.3.5335-5348

Keywords: Pitch; Fast Fourier transform (FFT); Fundamental frequency; Diatonic frequency; Tonal relationship

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INTRODUCTION

The sompoton is a mouth organ instrument found in Sabah, Malaysia. Though it is considered complicated, it is the most popular solo instrument. It is made from a gourd with bamboo tubes (Marasan 2003) and played especially in Sabah only (Frame 1982; Pugh-Kitingan 1992; Pugh-Kitingan 2000). The instrument consists of eight bamboo tubes (seven with a single free vibrating reed of palm bark set near the base of the tube) fitted together with a type of beeswax inside a hollowed gourd, which serves as the wind chest. Figure 1 shows the individual tubes, each with its own name such as tinangga (1), tuntutuk (2), rondom (3), baranat (4), monongkol (5), Gobou (6), lombohon (7), and suruk (8) (Marasan 2003). The lombohon does not produce sound and serves to balance the tube structure arrangement.

The tops of tubes 1, 2, 3, and 4 are covered with the second, third, fourth, and fifth fingers of the right hand to control the sounds. Tube 1 has holes at the top and bottom of the tube, while tube 5 has a hole at the bottom only, which is covered when the sound is needed (Fig. 2a). Tube 8 has a hole at the bottom, which is covered when the sound is needed (Fig. 2b). The normal method of holding the instrument is as follows, the gourd and lower part of the tubes are held in the left hand, which allows the thumb to control the holes at the bottom of tubes 1 and 5 while at the same time the second finger controls the hole at the bottom of tube 8. The second, third, fourth, and fifth fingers of the right hand are placed with their tips over the tops of tubes 1, 2, 3, and 4, which leaves the right-hand thumb free to control the hole located towards the top of tube 1. It should be noted that tube 1 has three methods of controlling the hole of the tube, that is, using the thumbs of both the right and left hands and the second finger of the right hand. Notes are selected by closing the holes at the bottom of the tubes 1 and 5 using the left-hand thumb (Fig. 2a) and closing the hole at the bottom of tube 8 with the left-hand second finger (Fig. 2b). Tube 6 with the lowest pitch sounds continuously as a drone. The tuning is a simple pentatonic scale, that is in A and gives the notes (low to high) E, F#, A, B, C#, E, F# (Missin 2016).

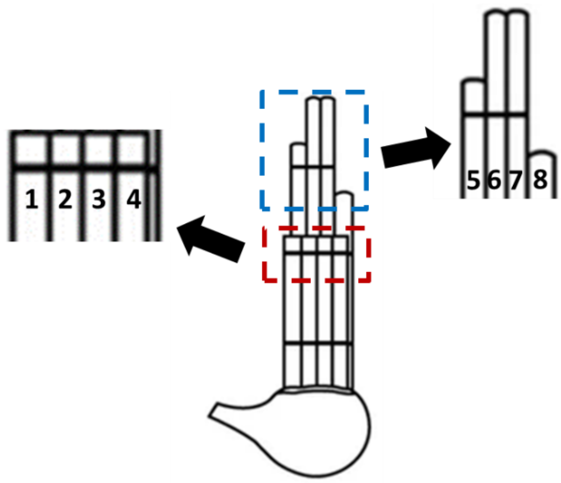

Fig. 1. The individual tubes: tinangga (1), tuntutuk (2), rondom (3), baranat (4), monongkol (5), Gobou (6), lombohon (7), and suruk (8) inserted in the gourd windchest

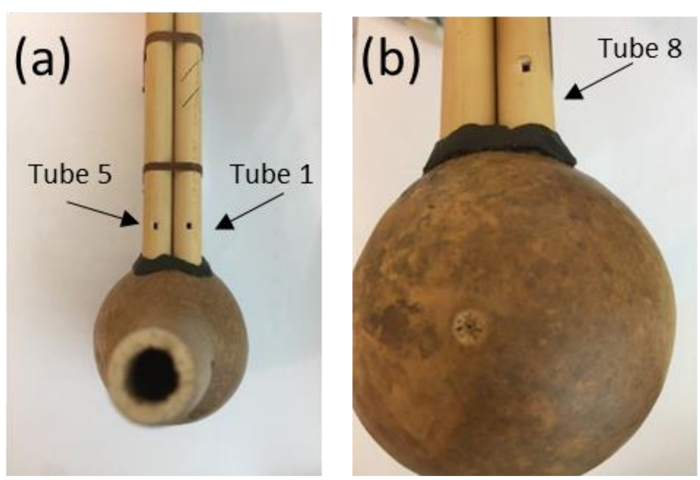

Fig. 2. (a) Tube 1 with the hole at the top and the base of the tube and tube 5 with the hole at the base only (b): Tube 8 with the hole at the base of the tube

The gourd used is classified botanically as *Lagenaria sinceraria*, or "bottle gourd" (Williams 1961). The suitable bamboo for the tubes is *Schizostachyum pilosum* locally known as lampaki. The stalks are cut into different lengths and dried. The bamboo tubes are bound together (four on one side) with a dried fern (*Athyrium filix-femina* (L.) Roth) and further secured by placing beeswax around and between the bases of the tubes. The fern stalk is cut, the skin peeled, and the strands from the inner side of the stalk taken and dried. These strands are split into fine strings and used as a string to tie the bamboo tubes together into a two layered raft. The beeswax is derived from a bee (*Trigona* bee, the largest genera of stingless bees and is used to seal the gaps between the bamboo tubes and the gourd. The reeds are cut directly from small palm (*Arenga pinnata*) lamellae. The bark of the palm tree is cut, and its skin peeled to make the vibrator. The vibrator does not have a fixed standard dimension to produce certain sound frequency and it depends on the expertise of the master crafter. The reeds are glued onto one end of the bamboo tube. Table 1 shows the materials for sompoton fabrication.

Table 1. Materials for Sompoton Fabrication

Bottle gourd	*Lagenaria sinceraria*
Bamboo tubes	*Schizostachyum pilosum*
Fern for binding	*Athyrium filix-femina* (L.)
Beeswax for securing	*Trigona* bee, largest genera of stingless bees
Reed fabrication	Bark of *Arenga pinnata* lamellae

The reed (vibrator) does not have a fixed standard dimension to produce certain sound frequency and it depends on the expertise of the master crafter. The maker's intuition permits him to create a specific ‘signature’ through sound that is unique to a given sompoton. Figure 3 shows section A and B that is scraped to obtain lower and higher pitches, respectively (Saidal 2018). Figures 4 (a) and (b) show tubes 1, 2, 3, and 4 (left to right) and (b): Tubes 5, 6, 7, and 8 (right to left, with tube no. 7 reed less), respectively.

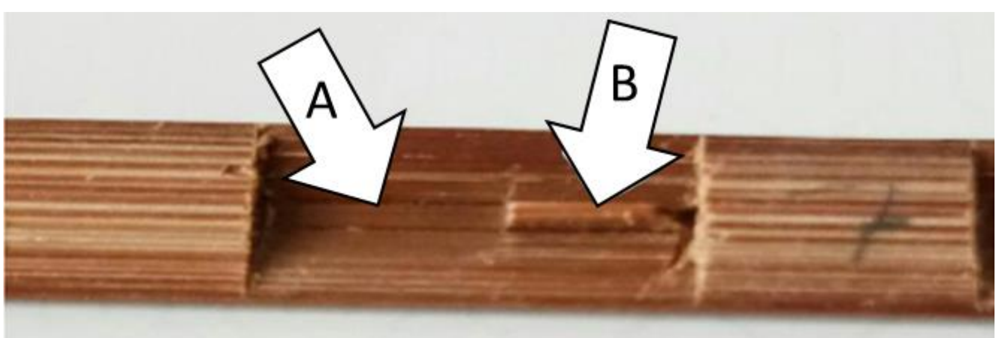

Fig. 3. The reed showing section A and B that is scraped to obtain lower and higher pitches, respectively (Saidal 2018)

The tuning is in a simple pentatonic scale that gives the notes (from low to high). The aim of the research was to identify the notes of the individual tube and determine the key to the instrument. This research stands out and is novel because not much research had been conducted to determine whether the finding is in accordance with previous studies that is in A major (Missin 2016), A# minor (Saidal 2018) and in C major (Wei and Dayou 2009). Wei and Dayou (2009) only studied the frequency characteristic of sound from sompoton musical instrument, whereas this study presented the musical key together with the 7 notes from the individual tubes.

Fig. 4. (a) Tubes 1, 2, 3, and 4 (left to right, length, L = 13cm) and (b) Tubes 5, (L = 19cm), 6 (L = 29cm), 7 (L = 29cm), and 8 (L = 26cm) (right to left) with tube no. 7 reed less. All tubes have similar diameter, D=11mm

MATERIALS AND METHODS

Figure 5 shows the 3 sompotons I, II, and III supplied by Kokoriu Enterprise, Kota Kinabalu, Sabah, Malaysia. The pitch of the individual tubes was determined *via* a Pico oscilloscope recording for both the time and frequency spectrum, which identified the fundamentals and overtones of the individual tubes using fast Fourier transform (FFT) analysis. Figure 6 shows the schematic diagram of the experimental setups in the laboratory at 25 °C and 60% relative humidity. The frequency of sound from each tube was determined by closing six tubes so that only the tube of interest produced sound. The frequency of each tube was collected in triplicate.

Fig. 5. Sompotons I, II, and III

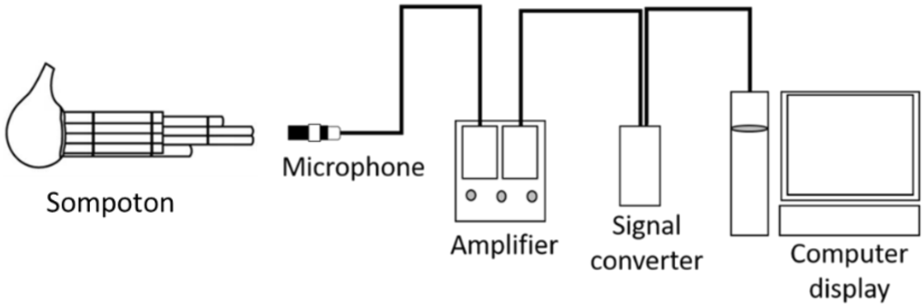

Fig. 6. Schematic diagram of the experimental setups

The microphone was held above the top surface along the axis of symmetry at a distance of approximately 20 cm. In this study, the audio signal derived from the striking by an expert player was recorded. The audio signal was recorded in mono, at a 24-bit resolution and a 48 kHz sampling rate. The audio signal was recorded with the aid of a digital audio interface in a wave format. To ensure the recorded audio signal was at the optimum level, audio signal calibration of the recording system was completed. A test tone of a 1.0 kHz sine wave was used to calibrate the recording system. In this study, the 'unity' calibration level was at +4 dBu or -10 dBV and was read by the recording device as '0 VU'.

In this regard, the European broadcasting union (EBU) recommended the digital equivalent of 0 VU; *i.e.*, the test tone generated for the recording device of the experimentation was recorded at -18 dBFS (Digital) or +4 dBu (Analog), which was equivalent to 0 VU. During this thorough calibration procedure, no device was unknowingly boosted, or its amplitude unknowingly attenuated in the signal chain at the time the recording was completed. The recording apparatus was an Audio-Technica AT4050 microphone (Audio-Technica Corp., Tokyo, Japan), XLR cable (balance), with the microphone position on an axis (less than 20 cm), and the microphone setting with low cut (flat) 0 dB. PicoScope computer software (Pico Technology, 3000 series, Eaton Socon, United Kingdom) was used to view and analyze the time signals from the PicoScope oscilloscopes (Pico Technology, 3000 series, Eaton Socon, United Kingdom) and data loggers for real time signal acquisition. The PicoScope software enables analysis using FFT, a spectrum analyzer, voltage-based triggers, and the ability to save/load waveforms to a disk. The amplifier (Behringer Powerplay Pro XL, Behringer, China) ensured that the sound capture was loud enough to be detected by the signal converter.

RESULTS AND DISCUSSION

Figure 7 shows a typical signal from the Pico oscilloscope recording both the voltage versus time (millisecond) signal (top) and intensity (dBu) versus frequency (kHz) spectrum (bottom) for tube 8 of sompoton I. The peaks in the spectrum are the fundamental (F_0) and overtones (F_n) frequencies produced by the tube and these frequencies are summarize in Tables 2 to 4. From the three instruments examined, the tunings were remarkably similar in the tonal relationships between the seven pitches (from 7 tubes) as shown in Tables 2, 3 and 4.

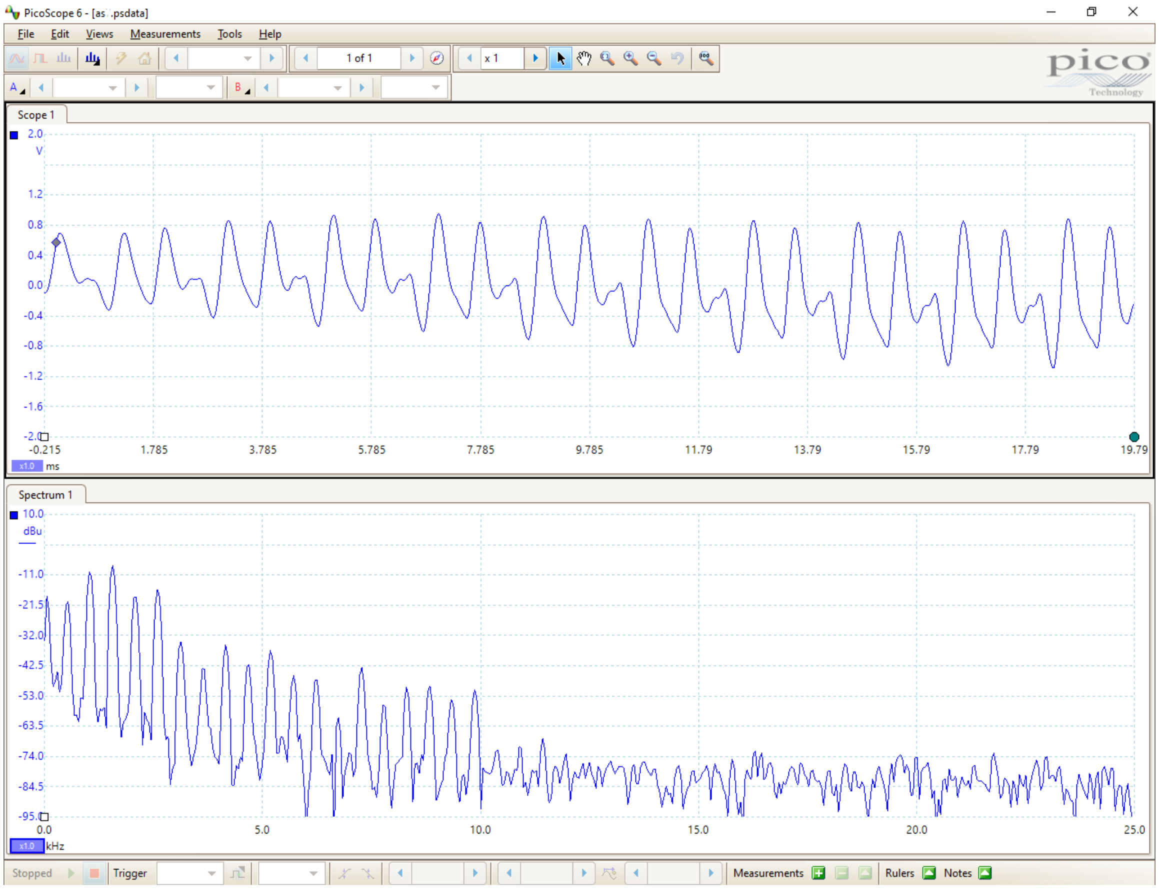

Fig. 7. A typical signal from the Pico oscilloscope recording both the voltage (Volt) versus time (millisecond) signal (top) and intensity (dBu) versus frequency (kHz) spectrum (bottom).

Table 2. Fundamental (F_0) and Overtones (F_n) Frequency (Hz) for Tubes 1 to 8 Obtained from Sompoton I

	Tube-1	Tube-2	Tube-3	Tube-4	Tube-5	Tube-6	Tube-7	Tube-8
F_0	924	758	655	589	449	407	-	537
F_1	1915	1543	1295	1151	841	779	-	1068
F_2	2865	2307	1956	1729	1254	1192	-	1584
F_3	3794	3154	2596	2307	1688	1584	-	2059
F_4	4723	3876	3257	2865	2121	1956	-	2575
F_5	5693	4640	3938	3484	2575	2286	-	3154
F_6	6623	5425	4558	4000	2947	2720	-	3691
F_7	7593	6251	5177	4578	3470	3071	-	4145
F_8	8543	6953	5879	5157	3814	3484	-	4661
F_9	9493	7717	6561	5735	4269	3876	-	5219
F_{10}	10480	8502	7160	6292	4661	4248	-	5714
F_{11}	11500	9348	7779	6829	5074	4682	-	6230
F_{12}	12500	10070	8440	7428	5508	5053	-	6747

Table 3. Fundamental (F_0) and Overtones (F_n) Frequency (Hz) for Tubes 1 to 8 Obtained from Sompoton II

	Tube-1	Tube-2	Tube-3	Tube-4	Tube-5	Tube-6	Tube-7	Tube-8
F_o	954	779	655	614	469	387	-	552
F_1	1912	1584	1295	1151	862	758	-	1089
F_2	2820	2328	1894	1729	1295	1213	-	1584
F_3	3762	3112	2575	2328	1688	1543	-	2121
F_4	4720	3938	3236	2947	2121	1915	-	2596
F_5	5678	4682	3856	3463	2596	2307	-	3092
F_6	6587	5446	4516	4083	2947	2658	-	3649
F_7	7561	6210	5157	4558	3360	3154	-	4186
F_8	8519	7015	5817	5113	3835	3463	-	4682
F_9	9461	7758	6416	5662	4227	3856	-	5198
F_{10}	10420	8605	7077	6240	4640	4207	-	5735
F_{11}	11360	9348	7717	6834	5115	4640	-	6251
F_{12}	12290	10150	8357	7379	5508	5053	-	6652

Table 4. The Fundamental (F_0) and Overtones (F_n) Frequency (Hz) for Tubes 1 to 8 Obtained from Sompoton III

	Tube-1	Tube-2	Tube-3	Tube-4	Tube-5	Tube-6	Tube-7	Tube-8
F_o	944	820	655	635	407	407	-	552
F_1	1853	1564	1295	1213	862	758	-	1027
F_2	2782	2307	1915	1770	1254	1171	-	1522
F_3	3752	3071	2555	2337	1729	1502	-	2039
F_4	4792	3876	3216	2927	2163	1894	-	2575
F_5	5611	4640	3835	3463	2575	2286	-	3092
F_6	6519	5404	4496	4062	2947	2741	--	3567
F_7	7552	6189	5136	4682	3422	3133	-	4165
F_8	8398	6932	5776	5329	3835	3463	-	4640
F_9	9348	7696	6375	5776	4269	3835	-	5157
F_{10}	10340	8481	7056	6375	4702	4227	-	5652
F_{11}	11130	9245	7676	6994	5115	4640	-	6230
F_{12}	12160	10050	8316	7572	5549	5033	-	6705

Tables 5 and 6 show the average frequency (from 3 sompotons I, II, and III for tubes 1 to 8, except tube 7) and the corresponding standard deviations. The fundamental pitch of drone tube (with the diatonic frequency and note in the bracket) at 400.3 Hz (392 Hz-G4 from tube 6) is always repeated an octave higher at 785.6 Hz (783.9 Hz-G5 from tube 2), the intervals of the perfect 4th higher at 547 Hz (554.3 Hz-C5# from tube 8), and the intervals of the perfect 5th higher at 612.2 Hz (622.5 Hz-D5# from tube 4). Although the pitch relationships remained constant, the instruments varied slightly in pitch level due to the inaccuracy in fabricating the reed. The standard deviations of the fundamental pitch from the three sompotons for tubes 1 to 8 (except tube 7) are 15.3, 31.5, 0.0, 9.2, 31.6, 11.5, and 8.7, respectively. The deviation in the frequency was due to the disparity of the free vibrating reed at the end of the tube.

Table 5. Average Fundamental (F_0) and Overtones (F_n) Frequency (Hz) for Tubes 1 to 8 Obtained from 3 Sompotons I, II, and III

	Tube-1	Tube-2	Tube-3	Tube-4	Tube-5	Tube-6	Tube-7	Tube-8
F_o	940.6	785.6	655	612.6	441.6	400.3	-	547
F_1	1893.3	1563.6	1295	1171.6	855	765	-	1061.3
F_2	2822.3	2314	1921.6	1742.6	1267.6	1192	-	1563.3
F_3	3769.3	3112.3	2575.3	2324	1701.6	1543	-	2073
F_4	4745	3896.6	3236.3	2913	2135	1921.6	-	2582
F_5	5660.6	4654	3876.3	3470	2582	2293	-	3112.6
F_6	6576.3	5425	4523.3	4048.3	2947	2706.3	-	3635.6
F_7	7568.6	6216.6	5156.6	4606	3417.3	3119.3	-	4165.3
F_8	8486.6	6966.6	5824	5199.6	3828	3470	-	4661
F_9	9434	7723.6	6450.6	5724.3	4255	3855.6	-	5191.3
F_{10}	10413.3	8529.3	7097.6	6302.3	4667.6	4227.3	-	5700.3
F_{11}	11245	9313.6	7724	6885.6	5101.3	4654	-	6237
F_{12}	12225	10090	8371	7459.6	5521.6	5046.3	-	6726

Table 6. Standard Deviations of the Fundamental (F_0) and Overtones (F_n) Pitch for Tubes 1 to 8 Obtained from 3 Sompotons I, II, and III

Std. Dev.	Tube-1	Tube-2	Tube-3	Tube-4	Tube-5	Tube-6	Tube-7	Tube-8
F_o	15.3	31.5	0.0	9.2	31.6	11.5	-	8.7
F_1	35.0	20.5	0.0	11.3	12.1	12.1	-	31.5
F_2	41.5	12.1	31.5	34.6	23.7	21.0	-	35.8
F_3	21.9	41.5	20.5	25.5	23.7	41.0	-	42.8
F_4	40.7	35.8	20.5	46.0	24.2	31.5	-	12.1
F_5	43.7	24.2	54.4	21.9	12.1	12.1	-	35.8
F_6	52.8	21.0	31.6	56.6	0.0	43.2	-	63.1
F_7	21.5	31.5	20.5	47.4	55.1	43.2	-	20.5
F_8	77.7	43.2	51.9	53.0	12.1	12.1	-	21.0
F_9	76.2	31.5	97.7	50.9	24.2	20.5	-	31.5
F_{10}	70.2	66.4	55.0	77.8	31.5	20.5	-	43.2
F_{11}	162.6	59.5	51.9	324.6	23.7	24.2	-	12.1
F_{12}	91.9	52.9	63.2	351.4	23.7	11.5	-	29.7

From Tables 2, 3 and 4, the Figs. 8, 9 and 10 were plotted to show the changes in frequencies from the first (F_0) to the thirteenth (F_{12}) harmonics for tubes 1 to 8 obtained from sompotons I, II, and III. The F_o denotes the first harmonics frequency for each tube. From Table 5, Fig. 11 was plotted to show the change in frequencies from the first harmonics to the thirteenth harmonics for tubes 1 to 8 obtained from the average values of 3 tubes from sompotons I, II and III. The pitch of the tube was not based on the open-end pipe principle (one end is closed), although Fig. 11 shows that the harmonic frequency is proportional to the harmonic number. It also does not follow the closed-end principle because the first four tubes have similar lengths but produce different frequencies. The different pitch is purely caused by the reed tuned by the master crafter.

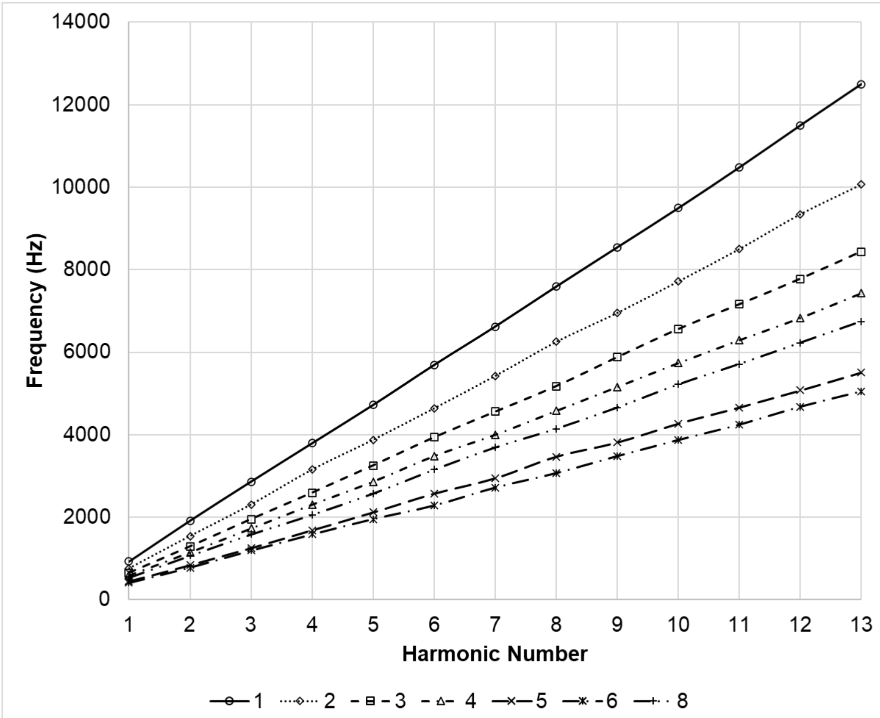

Fig. 8. The change in frequencies from the first harmonics to the thirteenth harmonics for tubes 1 to 8 obtained from sompoton I

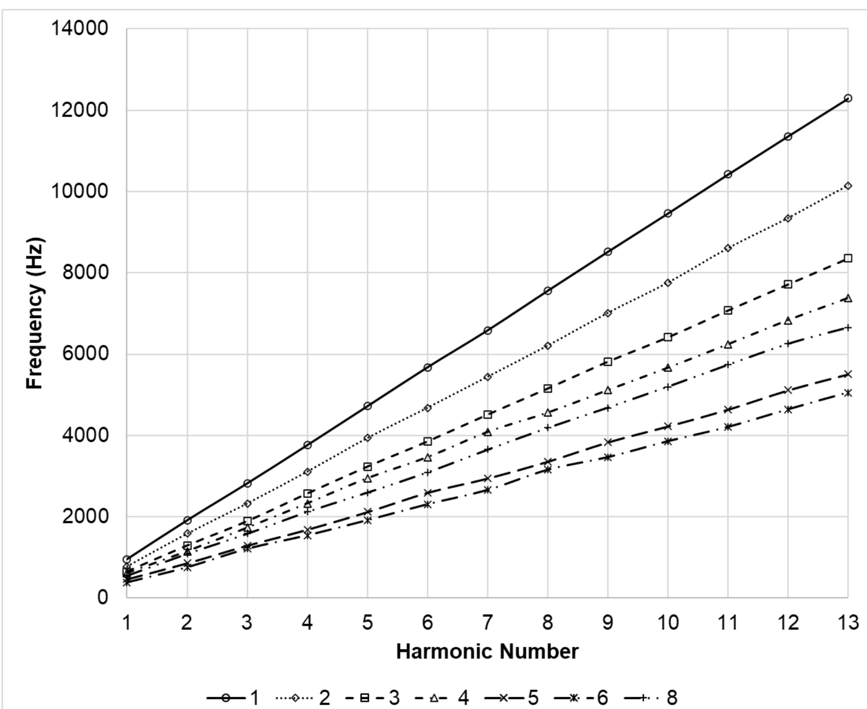

Fig. 9. The change in frequencies from the first harmonics to the thirteenth harmonics for tubes 1 to 8 obtained from sompoton II

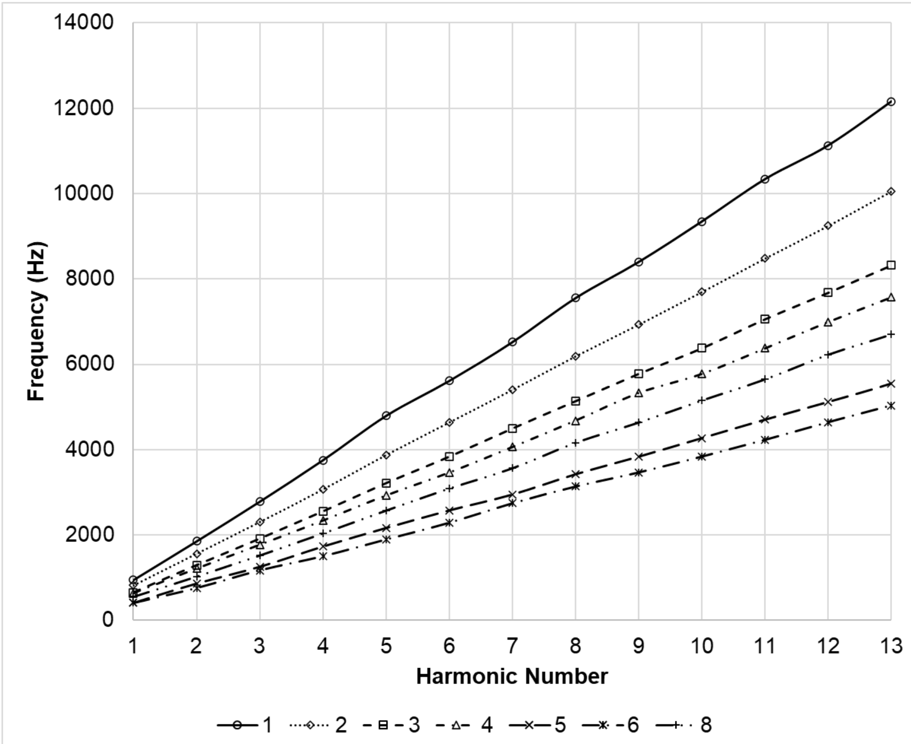

Fig. 10. The change in frequencies from the first harmonics to the thirteenth harmonics for tubes 1 to 8 obtained from sompoton III

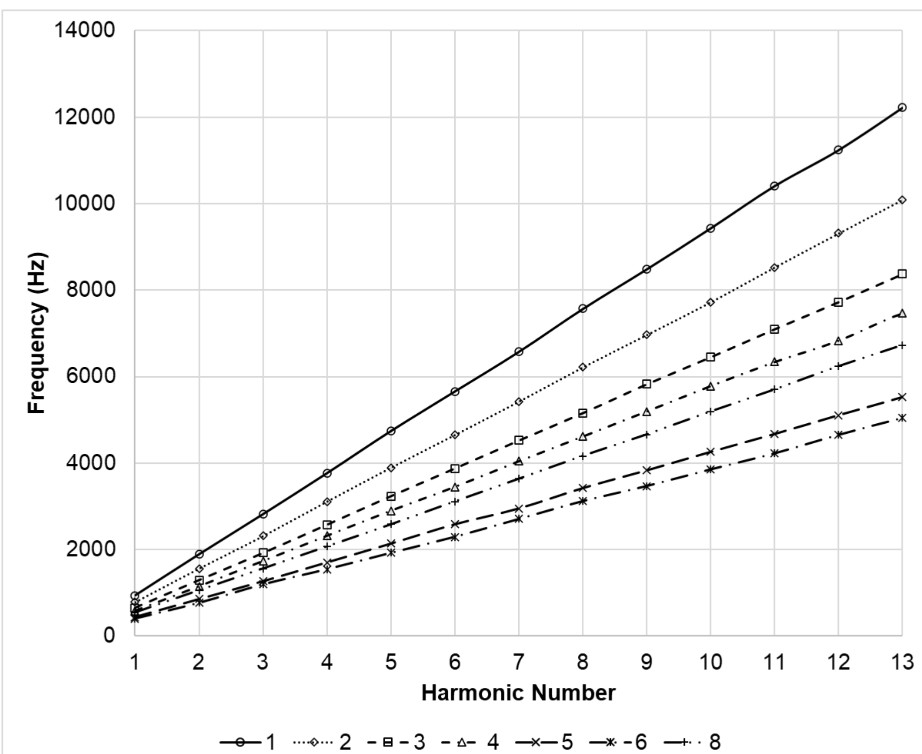

Fig. 11. The change in frequencies from the first harmonics to the thirteenth harmonics for tubes 1 to 8 obtained from the average values of 3 sompotons

Table 7 shows the pitch of the individual tube. Table 7 was reorganized so that the fundamental pitch of the individual tube obtained from the 7 tubes was arranged based on an equal tempered scale (ETS). From Table 7, it is evident that the frequency of the tube decreases from tube 1 to 4 (with similar length), followed with tube 8, 5, and 6 that gradually increased in length. From Table 7, the tuning is in a simple pentatonic scale that gives the notes (from low to high) as follows 400.3 (tube 6: G4), 441.6 (tube 5: A4), 547, (tube 8: C5#), 612.6 (tube 4: D5#), 655 (tube 3: E5), 785.6 (tube 2: G5), and 940.6 (tube 1: A5#). The notes G4, A4, C5#, D5#, E5, G5, and A5# are not exactly in G because C5#, D5#, and A5# are not in the key of G, which consists of the pitches G, A, B, C, D, E, and F#. This result is also not in accordance with previous studies with the tuning in a simple pentatonic scale that is in A major that gives the notes (from low to high) as follows E, F#, A, B, C#, E, F# from Missin (Missin 2016), and in A# minor that give B5b, G5#, F5, D5#, G4#, C5#, and A4# from Saidal (Saidal 2018) and in C major that give the notes G5, F5, D5, C5, A4#, G4, and F4 from sompoton A in Wei and Dayou (Wei and Dayou 2009). The closeness of the tuning to ETS was given here purely as a reference and comparison. Each sompoton is tuned accordingly to a region from where it belongs because it is done purely by listening. Each sompoton was developed and constructed according to its own tuning standards according to its district.

Table 7. Pitch of the Individual Tube Compared with Previous Studies (Wei and Dayou 2009; Missin 2016; Saidal 2018)

Tube		1	2	3	4	8	5	6	Key
This work (Average of 3)	Frequency	940.6	785.6	655	612.6	547	441.6	400.3	-
	Note	A5#	G5	E5	D5#	C5#	A4	G4	Gmajor
Missin 2016	Note	A	B	C#	E	E	F#	F#	Amajor
Saidal 2018	Frequency	945	833	706	628	428	565	462	-
	Note	B5b	G5#	F5	D5#	G4#	C5#	A4#	A#minor
Wei and Dayou 2009 (Sompoton A)	Frequency	791	704	587	523	468	382	349	-
	Note	G5	F5	D5	C5	A4#	G4	F4	Cmajor
Wei and Dayou 2009 (Sompoton B)	Frequency	677	593	498	449	392	332	297	-
	Note	E5	D5	B4	A4	B4	E4	D4	Dmajor
Wei and Dayou 2009 (Sompoton C)	Frequency	696	624	516	478	414	338	308	-
	Note	F5	D5#	C5	B4	G4#	E4	D4#	Cmajor

From Table 5, the average frequency for each tube obtained from 3 sompotons is normalized by dividing the frequency of each tube by its respective fundamental frequency as shown in Table 8.

From Table 8 the harmonic ratios were plotted against the harmonic number as shown in Fig. 12. The straight line in Fig. 12 is the theoretical harmonic ratio. It can be concluded that tube 1 yielded almost perfect harmonic ratio. The harmonic ratios for all tubes were in accordance with the theoretical harmonic ratio at lower harmonic number up to 4^{th} harmonic. As the harmonic number increased, the harmonic ratio tended to slightly decrease from the theoretical harmonic ratio, except for tube 1. This deviation is suggested to be caused by the distance of the reed from the blowing source where tube 1 is the closest to the blowing source.

Table 8. The Ratio of the Average Frequency with Respect to the Fundamental Frequency Obtained from 3 Sompotons for the 1st to 13th Harmonics

	Tube-1	Tube-2	Tube-3	Tube4	Tube-5	Tube-6	Tube-8
1stHarmonic/F_0	1	1	1	1	1	1	1
2ndHarmonic/F_0	2.01	1.99	1.98	1.98	1.94	1.91	1.94
3rdHarmonic/F_0	3	2.95	2.93	2.98	2.87	2.98	2.86
4thHarmonic/F_0	4.01	3.96	3.93	3.99	3.85	3.85	3.79
5thHarmonic/F_0	5.04	4.96	4.94	4.99	4.83	4.8	4.72
6thHarmonic/F_0	6.02	5.92	5.92	5.93	5.85	5.73	5.69
7thHarmonic/F_0	6.99	6.91	6.91	6.95	6.67	6.76	6.65
8thHarmonic/F_0	8.05	7.91	7.87	7.94	7.74	7.79	7.61
9thHarmonic/F_0	9.02	8.87	8.89	8.94	8.67	8.67	8.52
10thHarmonic/F_0	10.03	9.83	9.85	9.95	9.64	9.63	9.49
11thHarmonic/F_0	11.07	10.86	10.84	10.90	10.57	10.56	10.42
12thHarmonic/F_0	11.96	11.86	11.79	11.41	11.55	11.63	11.4
13thHarmonic/F_0	13	12.84	12.78	12.40	12.5	12.61	12.3

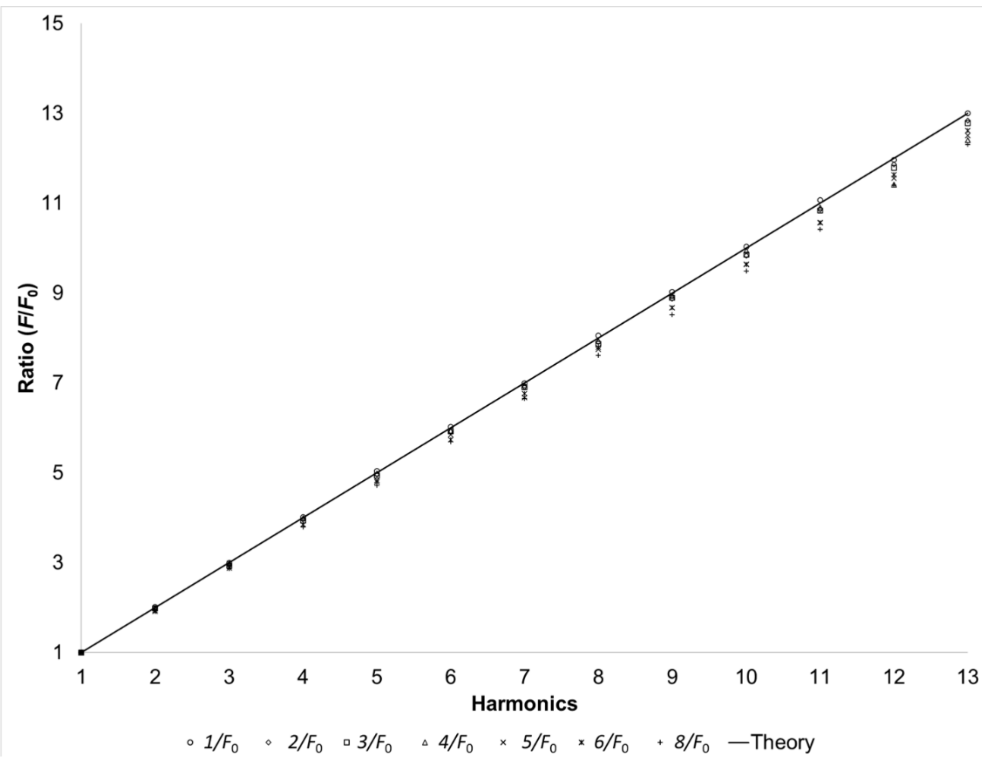

Fig. 12. The harmonic ratio *versus* harmonic number; the straight line is the theoretical harmonic ratio

The results revealed that the sompotons were properly tuned even though the tuner solely tuned it based on hearing, a skill that is passed down from generation to generation. The instinctual knowledge or comprehending the pitch where the intuitive tuning is based on the crafter's feelings is solely based on hearing rather than facts or proofs using their own references. It is found that one sompoton intonation, tone, and feel are always different from another because each sompoton is tuned accordingly to a region from where it belongs and it is done purely by listening. Each sompoton was developed and constructed accordingly to its own tuning standards from their district. In this study, PicoScope yielded the best sound from the sompoton set where the primitive hearing was replaced by PicoScope. It was demonstrated that all the three sompotons transmit almost the exact pitch as shown on the aspect of intonation and tone. The PicoScope showed complex tone with their fundamental almost equivalent to equal tempered scale (ETS). One aspect that needs to be considered in this study is the sound characteristic sense. The sense, which is derived from the maker himself, allows him to craft a specific "signature" through sound characteristic of a particular sompoton. Sompoton is exclusively handmade produced and constructed through primitive tools and processing and has a sound that is bound to the aesthetics to a region from where it belongs.

CONCLUSIONS

1. The fundamental and the overtones harmonics of sompoton set were determined. The pitch of the individual tube was independently analyzed with 13 harmonics observed. The overtones harmonic was in almost exact ratio with the fundamental frequency of each tube.
2. Each harmonic of every tube showed a harmonic ratio comparable with the theoretical value. The harmonic ratio of tube 1 was in accordance with the theoretical ratio up to the 13^{th} harmonic. This is caused by the position of tube 1 being close to the blowing source in the windchest. The other tubes are close to the theoretical value up to the 4^{th} harmonic.
3. The sompoton displays tuning in a simple pentatonic scale. The notes start from G4 *i.e.*, 400.3 (tube 6), A4 *i.e.*, 441.6 (tube 5), C5# *i.e.*, 547 (tube 8), D5# *i.e.*, 612.6 (tube 4), E5 *i.e.*, 655 (tube 3), G5 *i.e.*, 785.6 (tube 2), and A5# *i.e.*, 400.6 (tube 1). The note is considered in the key of G (G, A, B, C, D, E, and F#) because it consists of the pitch G4, A4, C5#, D5#, E5, G5, and A5 except with the C and D in the sharp key. The pentatonic scale in G key is G, A, C, D, and E.
4. The pitch of the tube is not based on the open-end pipe principle although the result shows that the harmonic frequency is proportional to the harmonic number. It also does not follow the closed-end principle because the first four tubes have similar lengths but produce different frequencies. The different pitch is purely caused by the reed tuned by the master crafter.
5. The crafter tuned the sompoton manually and Mother Nature proved that the sompoton was successfully tuned close to the equal tempered scale.

ACKNOWLEDGMENTS

The authors are grateful to Universiti Malaysia Sarawak for the financial and technical support and to Prof. Dr. Taufik Yap Yun Hin from Universiti Malaysia Sabah for supplying the three sompotons.

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Article submitted: April 19, 2022; Peer review completed: July 17, 2022; Revised version received and accepted: July 25, 2022; Published: July 29, 2022.
DOI: 10.15376/biores.17.3.5335-5348