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Article

The Exploration of Deli Malay Language Vowels: An Acoustic Phonetic Analysis

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Submission Track

Received: February 13, 2024
Final Revision: March 19, 2024
Accepted: March 21, 2024
Available Online: April 5, 2024

Keywords

Phonetics, acoustics, Deli Malay Language vowels

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A B S T R A C T

This study aims to discuss the acoustic profile of Deli Malay Language (Bahasa Melayu Deli) vowels from phonetics. In collecting data, the research will involve 15 DML native speakers. The speakers involved were between 20-40 years old. The data was obtained by recording the speaker's voice in a quiet room with a consistent microphone distance of about 30 centimeters from the lips. Teak speakers will read syllable words containing target vowels in sentences with DML vowels. The pronunciation target vowel is placed on the first syllable. This study found that Deli Malay has seven vowels, namely vowels /i/, /e/, /ə/, /a/, /o/, /u/ and /ɔ/. DML vowel positions /i/ and /e/are high and medium front vowels. While the vowels /o/, /u/ and /ɔ/ are high and medium back vowels. Meanwhile, the vowels /a/ and / ə / are mid and low mid vowels. Later, this acoustic study calculated approximate vowel measurements based on F1 and F2 from the spectrogram at Praat. The measurement of the sound quality of forman vowels in Malay deli vowels is vowel /a/ F1 = 876 Hz and F2 = 1701 Hz vowel /i/ F1 = 533 Hz and F2 = 2328 Hz, vowel /e/ F1 = 689 Hz and F2 = 2204 Hz, vowels / ə/ F1= 692 Hz and F2= 1686 Hz, vowels /o/ F1= 650 Hz and F2= 1459 Hz, /ɔ/ F1= 658 Hz and F2= 1373 Hz, and /u/ F1= 524 Hz and F2 = 1383 Hz. This study provides a detailed analysis of the acoustic properties of Deli Malay vowels, contributing to a deeper understanding of the phonetic characteristics of the language. This can be valuable for linguists and researchers studying Malay languages and their phonetic systems.

I. INTRODUCTION

Malay Language (*Bahasa Melayu*) is the identity and shape of Malay culture and ideology. ML is included in the safe condition that it is still spoken by all ethnic groups (Ministry of Education and Culture, 2019). ML speakers reach 20,000,000 speakers (Pramuniati et al., 2024; Tondo, 2009). Considering the number and the recent decrease of ML speakers, ML needs to be protected and developed through research. Deli Malay is a dialect of the Malay language used by the Deli Malays. This language is spoken in Medan, Deli Serdang, and Serdang Bedagai. The Deli Malay Language is also used as a means of communication, culture supporter, and identity symbol of the Deli Malays. This language function is realized in the activities of the Malay community in everyday life, including in formal and informal situations.

Based on the previous studies, The main problem in this study is that until now, the Deli Malay Language has received less attention in terms of phonetic scientific aspects, primarily acoustic phonetics. Studies on DM Languages using an acoustic-phonetic perspective are still rare. This study aims to discuss the acoustic profile of DML's vocals from the aspect of phonetic science. To describe the characteristics of DML's vocals acoustically against vowel sounds empirically. This study also aims to document language's physical sound, preservation, teaching, and dignity amid the current symptoms of language shift. In line with the scientific aspects of phonetics and the mandate

DOI: https://doi.org/10.25077/ar.11.1.39-48.2024

Fig.1 Deli Serdang Regency
Source: wikipedia

of the 1945 Constitution, UNESCO (2010) urges all countries in the world to protect the heritage of regional languages and literature so that they do not become extinct, which will lead to the extinction of the next generation who are virtuous and have local wisdom.

Describing the vowels of the Deli Malay language elevates the dignity of the language, which now tends to be displaced by the Indonesian language, which is, in fact, more substantial. Second, the acoustic description of these vowels can be a reference or guideline in assessing speech disorders. Speech deviation or acoustic deformation of speech can be seen from the deviation of the acoustic values of the vowel sounds. Disturbances in the pronunciation of vowel sounds can be identified through the differences in the acoustic values produced by speakers who experience speech disorders with the acoustic values of regular speakers.

Third, the acoustic description of Malay deli vowels can be used for teaching, especially for the benefit of outsiders interested in learning the Deli Malay Language. It should be noted that the acoustic data of a language reflect the behaviour of our speech organs when producing language sounds. The condition of the oral cavity, which includes the high-low position of the tongue, the contraction of the front-back parts of the tongue, and the proportion of open-closed mouth openings, can be known through the acoustic data of the identified vowels.

In the linguistic context of local languages in Indonesia, there have been several studies that also described vowel sounds in local languages using an acoustic-phonetic approach, for example, those conducted by Perwitasari (2017), Yusuf (2017), Rohman & Misnadin (2020), and Yusuf et al. (2021). This is undoubtedly encouraging, even though it has only been done in recent years. Perwitasari's study of vowels in Javanese and Sundanese concluded that the type of phonation influenced the acoustic quality of vowels in Javanese and Sundanese. Concerning phonation, Perwitasari's findings prove that the decrease in the first formant (F1) is a characteristic that usually occurs in vocal quality after the /b/ sound (slack-voiced stop) and is consistent. Furthermore, it was also found that the Javanese articulated the vowel /ə/ instead of the pepet vowel /ə/ after the consonants /b/ and /h/. This leads to a high-mid central vowel position in the vowel sound articulation area.

Acoustic phonetics studies sound waves as physical events or natural phenomena that form the relationship between speakers and listeners (Syarfina, 2009). According to Harrington (2010), acoustic phonetics is a science that has received contributions from three fields of science, namely linguistics (phonology), engineering (electronics), and cognitive (psychologists). A subfield of general phonetics that studies the physical properties of speech sound in terms of frequency (pitch), intensity (spectrum), and quantity (duration) (Bussmann, 2006). Acoustic phonetics is the study of the acoustic characteristics of speech, including analysis and description of speech in terms of its physical properties, such as frequency, intensity, and duration. Syarfina (2009) argues that acoustic characteristics consist of frequency or melodic structure duration, also called temporal structure and intensity.

Vowels are the sounds humans produce regarding sounds and vowels expressed by /a/, /e/, /i/, /o/, /u/. The most common view is that vowels are sounds in which there is no obstruction to the flow of air as it passes from the larynx to the lips (Roach, 1998, p. 10). By drawing the tongue closer or less close to the roof of the mouth, we can vary the tube size. Each tube size will produce a different sound quality, hence a different vowel (Roca & Johnson, 1999, p. 116). According to Irawan (2017), by using acoustic phonetics, we can more accurately place the position of a vowel sound among other vowel sounds than by using articulatory and auditory approaches. The sounds of the Deli Malay language consist of 32 phonemes consisting of 9 vowel phonemes and 23 consonant phonemes (Manurung & Zubeirsyah, 1984 , p. 12). The following table elaborates the description of the nine vowel phonemes, namely: /i/, /u/, /I/, /ē/,

/ə/, /o/, /E/, /O/, /Ø/, /a/.

Table 1. DML Vowel Mappinp

Vowel sound variations	Front	Central	Back
Close	I		u
	I		
Mid	Ē	ə	o
	E		O
			Ø
Open		a	

On the other hand, Sundanese speakers surprisingly pronounce the sound /ɨ/ in the high near-front position in the vowel sound space and are advised to transcribe the vowel /ɨ/ with /ʏ/. A study conducted by Yusuf (2017) on Sundanese found that vowels in Sundanese were relatively lower than English vowels. Except for the /Ĕ/ sound. Both central vowel sounds in Sundanese, the /Ĕ/ and /ə/, spoken by Sundanese women, are lower than the schwa sound in English. The vowel /ə/ in Sundanese is lower than the schwa in English, but the vowel /Ĕ/ is slightly higher than in English.

Misnadin (2020) ɛ, ə, ɔ, ɤ, i, ɨ, u], but there have been disagreements with regard to the number of its vowel phonemes. The disagreements arise partly because some scholars base their analyses of Madurese vowels on phonetic grounds while others base them on certain phonological analyses. Besides, some researchers do not consider native versus non-native Madurese words in their analyses. The paper addresses these problems by incorporating both phonetic and phonological analyses in order to provide a better description of Madurese vowels. To achieve this, we investigated the acoustic realisations of the eight surface vowels by looking at the first and second formant frequencies (F1 and F2 explored the acoustic quality of vowels in Madurese language. Misnadin's study concluded that Madurese's high and low vowels significantly differed in the first formant (F1). However, the second formant (F2) is more varied. The vowel pair [ɨ ~ ə] differs significantly in vowel onset. In the middle area of the pair, vowels [i ~ ɛ] and [ɨ ~ ə] differ significantly. The vowels [ɤ] and [ɨ] as well as [ɤ] and [ə] also differ in their F1 and F2 values. Misnadin's study confirmed that the vowel pairs are significantly different. The analysis results explained that the Madurese language should be described as a language with a four-vowel system. Misnadin claimed that his study offers a solution to the confusion over the number of vowel phonemes in the Madurese language

Another study of local language vowels using an acoustic-phonetic approach was conducted by Yusuf et al. (2021) on the Jamee language in South Aceh, which is only spoken by 77,000 people. This study is an effort to document and preserve minor languages in Indonesia. The study also resolved the confusion over the number of monophthongs in the Jamee language. Research conducted by Yusuf et al. investigated the vowel quality in that language involving ten female speakers of the Jamee language and used the Praat as an analysis tool. The results of this study found seven monophthong vowels: /i/, /e/, /ɛ/, /a/, /o/, /u/, and /ɔ/ with a description of the F1 and F2 formant frequencies for these vowels.

What is new from this study is the analysis of the acoustic quality of Deli Malay vocals. Previous research has yet to look at this section, where previous research only focused on greetings, speech acts, the use of verbs through semantic analysis, language variations, lexicostatistics, and others. Therefore, in addition to filling the gaps in the description of the Deli Malay Language, this research also offers something new in the treasury of research related to Deli Malay as one of the languages in Sumatera Utara. This study does not only measure the acoustic component of the formant frequency as conducted by Perwitasari (2017), Yusuf (2017), Misnadin (2020)ɛ, ə, ɔ, ɤ, i, ɨ, u], but there have been disagreements with regard to the number of its vowel phonemes. The disagreements arise partly because some scholars base their analyses of Madurese vowels on phonetic grounds while others base them on certain phonological analyses. Besides, some researchers do not consider native versus non-native Madurese words in their analyses. The paper addresses these problems by incorporating both phonetic and phonological analyses in order to provide a better description of Madurese vowels. To achieve this, we investigated the acoustic realisations of the eight surface vowels by looking at the first and second formant frequencies (F1 and F2 , and Yusuf et al. (2021), but this research also includes measurements of the acoustic components of the fundamental frequency (f0), and the duration of the targeted vowels in order to describe a comprehensive acoustic profile of the vowel sounds. Acoustic research with the target of vowel sounds as the object of study will generally observe the spectrogram and wave pattern of the sound. Differences in sound energy

patterns of all types of sounds and even all language sounds can be seen from the acoustic realization of the spectrogram and the sound wave pattern. Each type of sound has unique characteristics as the main feature that distinguishes it from other types of sound. To see the unique characteristics of vowel sounds, linguists generally identify the formant frequencies of these vowel sounds as the main acoustic component that distinguishes one vowel sound from another. The combination or configuration of vowel sound formant frequencies is often called vowel sound quality. The quality of the vowel sound forms the acoustic characteristics of each vowel sound.

Language studies related to the acoustic quality of vowel sounds can be traced accurately since the research conducted by Peterson & Barney (1952), which was sponsored by Bell Telephone Laboratories, is the most widely referenced research on the same topic. They measured the formant and fundamental frequencies of American English involving 33 male, 28 female, and 15 children informants. Peterson and Barney used the structure /hVd/ in American English to obtain data on the ten vowel monophthongs in English. The results of the research conducted by Peterson Barney (1952) concluded that there is a strong relationship between the target vowel sounds and the formant frequencies. However, they also found that there were formant variations among the speakers who were the subjects of the researc

Peterson & Barney (1952) research footprints were followed by many other phonetic researchers, namely (1) studied the acoustic quality of vowel sounds in the same language, that is English (Hillenbrand et al., 1994; Lunden, 2017), (2) studied acoustic quality of language other than English (Evans 2006; Vaishna & Misra 2010; Recasens 2021), (3) compared the acoustic quality of vocals in one language with the acoustic quality of another language, (Bradlow, 1995; Ahmed & Grosvald 2019), or (4) examined the existence of pronunciation interference or perception of vocals in one language to pronunciation or perception of vocals in other languages (Perwitasari 2018; Baigorri et al. 2019; Adnan et al. 2020; Conklin & Dmitrieva 2020). From the existing studies, it can be concluded that the studies of vowel sound quality in several regional languages tend to utilize one acoustic parameter, namely the formant acoustic component. Second, except for the study conducted by Perwitasari, the languages studied tend to ignore the aspects of the language's dialect. Third, the study of vowel sounds involves one gender, as Yusuf et al. (2021) conducted. So, this study aims to discuss the acoustic profile of Deli Malay Language (Bahasa Melayu Deli) vocals from phonetics.

II. METHODS

This study is a phonetic study with a modern perspective since this study no longer uses traditional methods commonly used by linguists. During this time, the study of physical sounds or phonetics tends to use researchers' auditory and visual perceptions. Unlike the phonetic studies researchers in Indonesia generally carry out, this study uses a more modern method. This study will use software tested for its reliability in examining and measuring the acoustic components of speech. In this study, the researchers use Praat. This study can be a reference and model for studying sound in other regional languages in Indonesia.

In data collection, this study involved the native speakers of DML in Medan, Deli Serdang, and Serdang Bedagai areas. The total of speakers was 15 female speakers. The speakers involved were adults between 20 and 40 years old. They use the language for everyday interaction. The speakers' voices were recorded in a quiet room with a tape recorder and a consistent microphone distance of about 30 centimeters from the lips to obtain the best data. Teak speakers read the syllable words containing target vowels in carrier sentences. The words designated as targets include vowels in DML, with these target vowels positioned in the initial syllable. Participants were instructed to read random carrier sentences clearly and naturally, repeating this process four times. An instrument for data collection will be devised, incorporating sentences containing specific target vowels. The data will be condensed following the analysis to select critical elements, identify patterns, and eliminate superfluous information. Thus, the data has good acuity so that it is valid and the information can be conveyed clearly. In addition, according to Miles et al., (2014), the definition of "data reduction is a form of analysis that sharpens, classifies, directs, and discards unnecessary data and organizes data in such a way that conclusions can be drawn and verified."

This study used the data analysis method

obtained and analyzed based on the methods and steps described by Miles et al., (2014). At the analysis stage, voice data were extracted and coded using Praat version 6.0.54 (Boersama & Weenik, 2019). To obtain the acoustic profile of vowel sounds in DML, measurements of the acoustic components on the spectrogram and waveform at the peak (midpoint) of the acoustic energy of the vowel sounds that include the first formant (F1), the second formant (F2). Acoustic measurements were continued on the fundamental frequency acoustic component (f0). Then, proceed to measure the duration of vowel sounds in milliseconds. For data processing, acoustic measurement results will be created as data processing instrument templates in Excel format.

The unit of measurement for formants and fundamental frequencies is Hertz (Hz), but then it will be converted into Bark perceptual units for formants with the formula Zi = 26.81/(1+1960/Fi) - 0.53 (Traunmüller, 1988). Acoustic value data will be converted into diagrams and mapped in vowel plotting.

Data were analyzed by extracting voice data through Praat Spectogram software. Measure the acoustic components of vowel sounds, including the first formant (F1) and second formant (F2). Measurements of the first formant (F1) and second formant (F2) for each vowel in the target word, as well as in utterances from multiple sentences by teak speakers, were taken at the midpoint of the vowel (Pillai & Yusuf, 2012). According to Hossain et al. (2007), F1 and F2 are considered appropriate to explain the quality of monophthongs. The higher formants (i.e., F3, F4, F5) have less energy and do not provide adequate phonetic information than the low formants. F1 is related to high vowel tones, while F2 is related to the dimensional representation of front or back vowel tones (Jacobi, 2009; Watt & Tillotson, 2001). The calculations in this study initially used Hertz, the data obtained from voice analysis results. Then, the data were transferred to Excel in Hertz. Then, the data were converted to Bark with the formula (Deterding, 1997): Hz to Bark = 13 * ATAN (0,00076 * D2) + 3,5 * ATAN ((D2/7500) * (D2/7500)) (*D is data in columns in Excel F1 or F2, measured in Hertz).

As described in Table 2, the data analyzed in this study are only on the vowels that occur in the first syllable, namely the target vowels /i/, /e/, /ə/, /a/, /u/, /o/, and /ɔ/. While the vowels /I//E/occur in the middle of a word and the vowel / Ø/ at the end (Manurung et al., 1984, p. 7). The words spoken by each respondent in Praat were recorded at 44100 Hz, and then the words were stored in a WAV file and annotated to a text grid for further analysis.The bark scale is designed as a filter bank for auditory analysis signals such as speech (Stevens, 2000). It is essentially the human auditory system, consisting of 24 critical bandpass filters at the junction from low to high frequencies (Zwicker & Terhardt, 1980). Finally, the average values are plotted on F1-F2 charts, which provide information about the vowel descriptions of a language (Ladefoged, 2001).

Table 2. Word list

Vowels	Jamee Words	English
A	saya	I
U	kunci	Key
I	sikap	Attitude
E	lempar	throw
ə	betandang	visit
O	dokter	Doctor
ɔ	rokok	Cigarrete

III. RESULT AND DISCUSSION

After the data were analyzed by extracting voice data through Praat Spectogram software, this study obtained the results by measuring the acoustic components of vowels, which included the first formant (F1) and the second formant (F2). The results of data analysis show that the average frequencies for F1 and F2 of each vowel produced in Deli Malay from Deli Malay Language informants are shown in Table 3. In Table 3, the formant average values are shown by vowel measurements based on F1 and F2 from the spectrogram in Praat by using Hz and converted into Bark. The results of the average formant frequency analysis for F1 and F2 of each vowel in Deli Malay from Deli Malay informants are shown in the Table 3.

Table 3 shows the average formant values for DML vowels and illustrates DML vowel positions /i/, /e/, /ə/, /a/, /u/, /o/, and /ɔ/. In this figure, we can estimate vowel measurements based on F1 and F2 from the spectrogram in Praat. Furthermore, Figure 2 shows that the front vowel is the vowel /i/and/e/. Meanwhile, /a/ and / ə / are open, low, and middle vowels. Finally, /o/, /u/, and /ɔ/ are back vowels. Furthermore, each vocal quality in the vocal space based on its measurement is described in the Figure 2.

Table 3. Formant frequency analysis

Vowel	Ave. F1 (Hz)	Ave. F2 (Hz)	Ave. F1 (Bark)	Ave. F2 (Bark)
i	533	2328	4.8	12.39
e	689	2204	5.89	12.07
ə	692	1686	5.91	10.54
u	524	1382	4.73	9.43
O	650	1459	5.63	9.73
ɔ	629	1296	5.69	9.39
a	876	1701	7.03	10.59

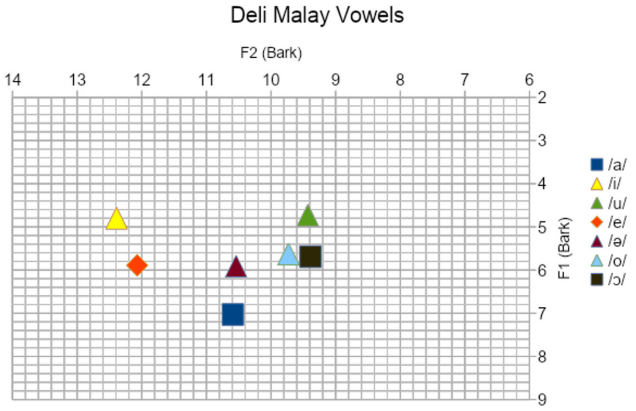

Fig. 2 Deli Malay vowel chart, in Bark scale

Vowel /i/ production

Figure 3 displays the distribution of the vowel /i/ as articulated by fifteen female speakers of Deli Malay. The data for the /i/ vowels in Deli Malay, drawn from the word 'attitude' in the word list comprising 15 letters, represent the high front vowel segment in Deli Malay. Consequently, this research observed the vocal quality of /i/ with F1 measured at 533 Hz and F2 at 2328 Hz.

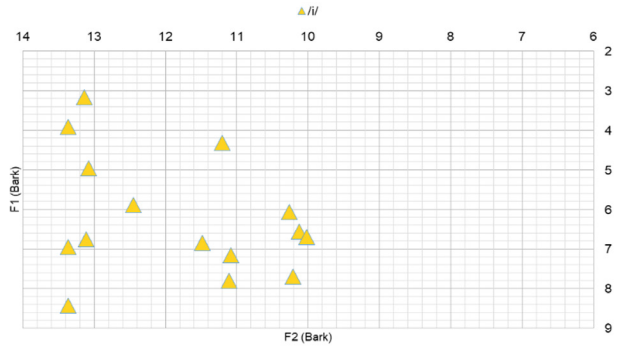

Fig. 3 Plot chart of the distribution of vowels /i/ as produced by speakers of Deli Malay

Vowel /e/ production

In Figure 4, we observe the vowel /e/ distribution as articulated by fifteen female speakers of Deli Malay. The data for the /e/ vowels in Deli Malay, derived from the word 'throw' within the 15-letter word list, represent the high front vowel segment in Deli Malay. As a result, this study

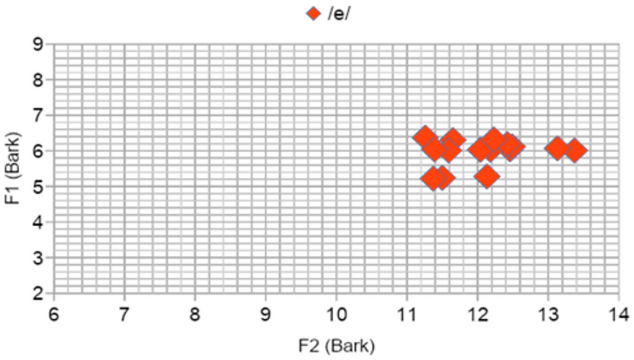

Fig. 4 Plot chart of vowels /e/ as produced by speakers of Deli Malay

identified the vocal quality of /e/ with F1 measured at 689 Hz and F2 at 2204 Hz.

Vocal /i/ and /e/ production

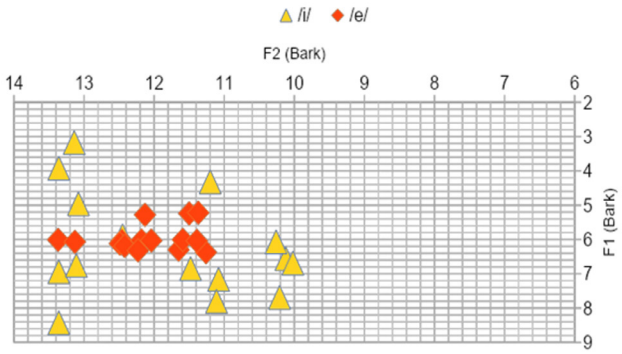

Fig. 5 Plot chart of the distribution of vowels /i/ and /e/ as produced by speakers of Deli Malay

Based on the quality of the front vowels, plot the vertical distribution of vowels /i/and /e/ in the vowel space, as illustrated in Figure 5. This study is similar to the study (Manurung et al., 1984), where they also found the position of the vowel /i/ as a high front vowel and /e/ as a medium front vowel in this language.

Vowel /ə/ production

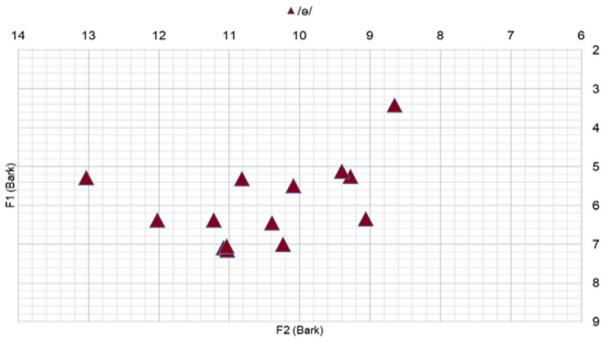

Fig. 6 Plot chart of vowels /ə/ as produced by speakers of Deli Malay

Figure 6 illustrates the distribution of the vowel /ə/ as produced by fifteen female speakers of Deli Malay. The data for the /ə/ vowels in

Deli Malay, extracted from the word 'betandang' meaning 'visit' in the 15-letter word list, represent the mid-vowel segment in Deli Malay. This study provides evidence that these vowels are articulated by speakers with the quality of /ə/, with F1 at 692 Hz and F2 at 1686 Hz.

Vocal /a/ production

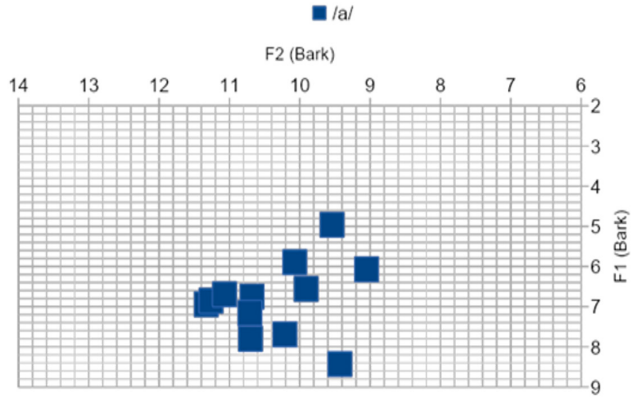

Fig. 7 Plot chart of the distribution of vowels /a/ as produced by speakers of Deli Malay

Figure 7 presents the distribution of the vowel /a/ as produced by fifteen female speakers of Deli Malay. The data for the /a/ vowels in Deli Malay, obtained from the word 'I' meaning 'me' in the 15-letter word list, represent the mid-low vowel segment in Deli Malay. This study provides evidence that these vowels are articulated by speakers with the quality of /a/, with F1 at 876 Hz and F2 at 1701 Hz.

Vowels /a/ and /ə/ production

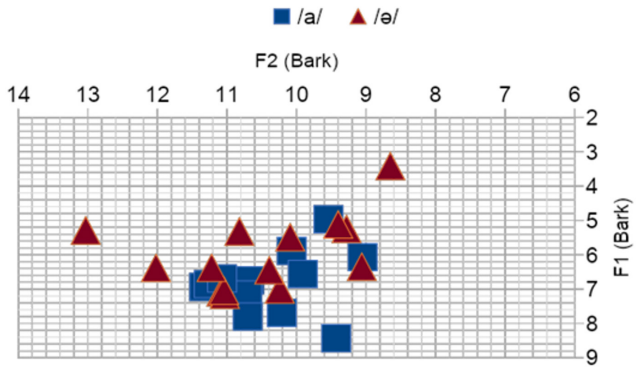

Fig. 8 Plot chart of vowels /a/ and /ə/ as produced by speakers of Deli Malay

Based on the quality of the front vowels, plot the vertical distribution of the vowels /a/ and /ə/ in the vowel space, as illustrated in Figure 8. This study is similar to the study (Manurung et al., 1984), where they also found the position of the vowel /a/ as a low middle vowel and /ə/ as a medium middle vowel in this language.

Vocal /ɔ/ production

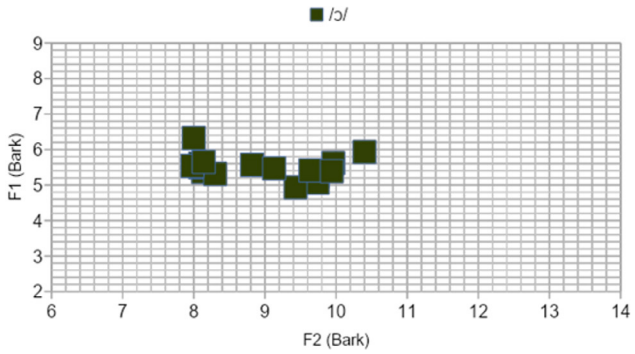

Fig. 9 Plot chart of the distribution of vowels /ɔ/ as produced by speakers of Deli Malay

Based on the quality of the front vowels, plot the vertical distribution of vowels /i/and /e/ in the vowel space, as illustrated in Figure 5. This study is similar to the study (Manurung et al., 1984), where they also found the position of the vowel /i/ as a high front vowel and /e/ as a medium front vowel in this language.

Vowel /o/ production

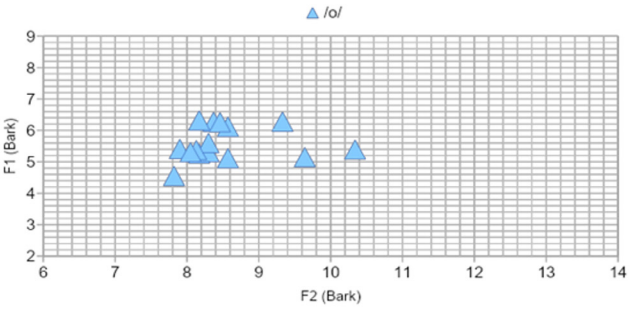

Fig. 10 Plot chart of vowels /o/ as produced by speakers of Deli Malay

In Figure 10, we observe the vowel /o/ distribution as produced by fifteen female speakers of Deli Malay. The data for the /o/ vowels in Deli Malay, extracted from the word 'doctor' in the 15-letter word list, represent the back middle vowel in the language. This study provides evidence that this vowel is articulated by speakers with the quality of /o/, with F1 measured at 650 Hz and F2 at 1459 Hz.

Plot of distribution of vowels /u/ produced by fifteen female speakers of Deli Malay in Figure 11. Plot of vowels /u/ for Deli Malay, in the total of 15 letters taken from the keyword 'key' in the word list. This vowel position can be seen as the high

Vocal /u/ production

back vowel part in Deli Malay. Thus, this study has proven that these vowels are produced by speakers with the vowel quality /u/, F1 = 524 Hz and F2 = 1382Hz.

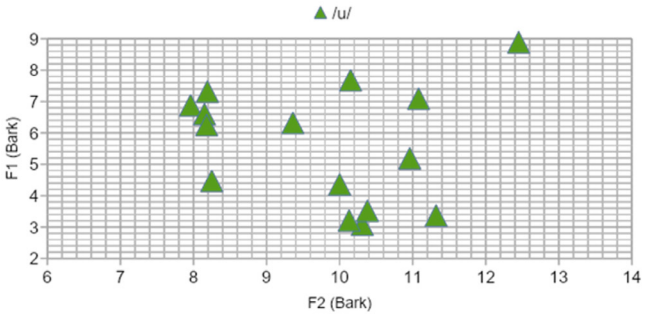

Figure 11 Plot chart of the distribution of vowels /u/ as produced by speakers of Deli Malay

Based on the quality of the front vowels, plots the distribution of /ɔ/, /o/, and /u/vertically in the vowel space, as illustrated in Figure 8. This study is similar to the study (Manurung et al., 1984), where they found vowel positions /ɔ/, /o/ as a medium back vowel, and /u/ as a high back vowel in this language.

Vowel /ɔ/, /o/, and /u/ production

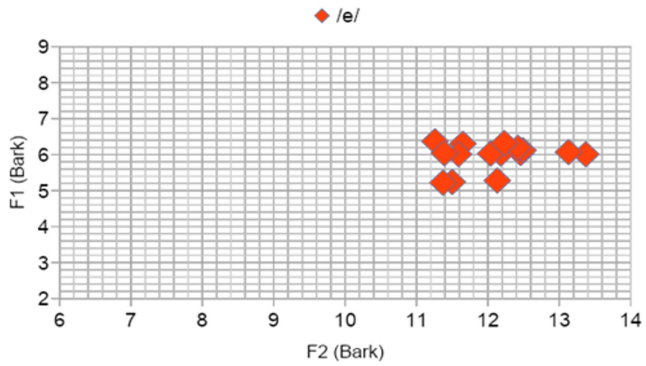

Figure 12 Plot chart of vowels /ɔ/, /o/, and /u/ as produced by speakers of Deli Malay

After observing the chart above in Figure 13 and Figure 2, we can describe that the vowels /i/ and /u/ are both in the front and back high vowel positions. A low F1 marks both, but the F1 vowel /u/ is lower than the F1 vowel /i/. Acoustic contrasts appear on the vowel F2 / u/ lower than the F2 vowel

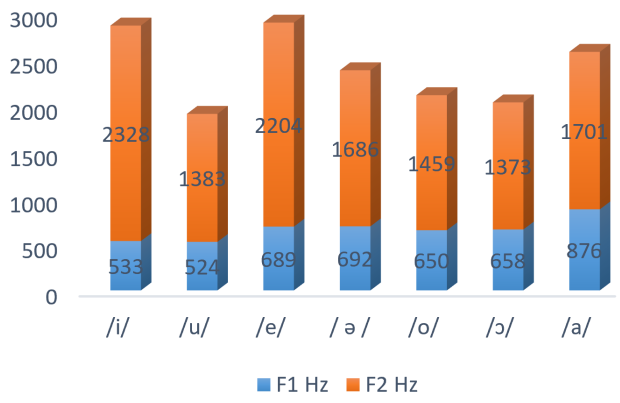

Figure 13 Deli Malay vowel measurement chart, in Hz scale

/i/. While the vocals /e/, /ə/ o/, and /ɔ / are both in the middle, front, and back positions. A medium F1 vowel marks the four, but the F1 vowel /ɔ / is the lowest among the four vowels in the medium position. Acoustic contrast is seen in the F2 vowel /ɔ / than the four vowels, and the F2 vowel /e/ is higher than the four vowels. The F1 vowel /a/ is low and back. The value of the F1 vowel /a/ is higher than the six other vowels, and the value of the F2 vowel /a/ is among the lowest F2 vowel /u/, compared to the values and F2 vowels, /ə/ o/, /ɔ/, /e/, and /i/.

Looking at the production of vowel utterances that have been studied from female speakers of Deli Malay, the positions /i/, /e/, /ə/, /a/, /o/, /u/, and /ɔ /, in the vowel space are similar to the seven vowels as described by (Manurung et al., 1984). The difference lies in the presentation of each vowel quality given by this study based on F1 and F2 from the spectrogram of each vowel in Praat. The front vowels are confirmed as /i/and /e/, the middle vowels are confirmed as /ə/and /a/, and the back vowels are confirmed as /u/, /o/, and /ɔ/ is the back vowel. Roach (2001, p. 39) further emphasizes the importance of studying acoustic signals for speech sounds because they are "fully observable: we can capture everything the listener hears in recorded form, and then measure whichever aspect of the signal we want to hear.

Research conducted by Yusuf et al. investigated the vowel quality in that language involving ten female Jamee speakers and used the Praat tool as an analytical tool. The results of this study found seven monophthong vowels: /i/, /e/, /ɛ/, /a/, /o/, /u/, and /ɔ/ with a description of the formant frequencies F1 and F2 for the vowels the. The results obtained from Van Zanten's research provide an overview of the Indonesian vowel system, which has six monophthongs in its vocal system, namely /i, e, a, o, u, a/. This study produces a phonetic description of the vowel quality of the Indonesian monophthong.

This study contributes by providing a detailed analysis of the acoustic properties of Deli Malay vowels, contributing to a deeper understanding of the phonetic characteristics of the language. This can be valuable for linguists and researchers studying Malay languages and their phonetic systems. In addition, the acoustic measurements provided in this study can be used to develop speech technology applications, such as automatic speech

recognition (ASR) systems, that require accurate representations of Deli Malay vowels for improved performance. Moreover, the acoustic profile of Deli Malay vowels can be compared with other Malay dialects or languages to identify similarities and differences in their phonetic systems. This comparative analysis can lead to insights into the evolution and divergence of Malay languages over time. By documenting the acoustic profile of Deli Malay, this study contributes to the preservation of the language and culture associated with Deli Malay speakers. It helps to ensure that future generations have access to accurate information about their linguistic heritage.

IV. CONCLUSION

This study found that Deli Malay has seven vowels, namely vowels /i/, /e/, /ə/, /a/, /o/, /u/ and /ɔ/. The vowel positions /i/ and /e/ in Deli Malay are high and medium front vowels. While the vowels /o/, /u/ and /ɔ/ are high and medium back vowels. Meanwhile, the vowels /a/ and / ə / are mid and low mid vowels. Later, this acoustic study calculated approximate vowel measurements based on F1 and F2 from the spectrogram at Praat. Measures of the sound quality of formant vowels in deli Malay vowels are vowel /a/ F1 = 876 Hz and F2 = 1701 Hz vowel /i/ F1 = 533 Hz and F2 = 2328 Hz, vowel /e/ F1 = 689 Hz and F2 = 2204 Hz, vowels / ə/ F1= 692 Hz and F2= 1686 Hz, vowels /o/ F1= 650 Hz and F2= 1459 Hz, /ɔ/ F1= 658 Hz and F2= 1373 Hz, and /u/ F1 = 524 Hz and F2 = 1383 Hz.

The findings of this research are significant in phonology, especially dialectology, because they help linguists preserve and document the language used by speakers of Deli Malay. However, this research was conducted with limitation only exploring the vowel of Deli Malay Language.

In relation to the conclusion, the researchers recommend further studies to be conducted on Deli Malay. Diphthong vowels and consonants must also be explored through an acoustic approach. Future research should also consider measuring vowel and consonant quality.

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