AN ACOUSTIC PHONETICS ANALYSIS OF ACEHNESE DIPHTHONGS

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Abstract

This acoustic study aims to describe how the Acehnese oral diphthongs are produced by five males and five females Acehnese speakers from Sigli with Pidie dialect. They are new coming students at the universities in Banda Aceh. They were selected to produce six diphthongs ending with /i/. The data were recorded from speakers' elicitating the target words containing rising diphthongs adopted from Yusuf (2013). The target word was repeated six times for six diphthongs.; then gaining 360 tokens in total. The ROC is suggested by Gay (1968) to obtain the diphthongs movement. To obtain ROC, F1 and F2 were calculated as the mean values in Hertz using PRAAT version 6.4.07. 10% onset and offset were applied to decide both F1 and F2; their values are used in a formula reproduced from Yusuf (2013) to find out the ROC of each diphthong. The /əi/ for both gender indicated a short movement; Female /oi/ has a small average F1 ROC value, which indicates that the vowel height has not changed.. The /ʌi/ production seems close to /oi/ and the shift of offset /ɔi/ is preceived to be centered within the vowel space.

Keywords: Acehnese; Acoustic Analysis; Oral Rising Diphthongs; Pidie Dialect

INTRODUCTION

In Indonesia, many local languages are found from various tribes and this has become one of the characteristics of Indonesian culture. One of the local languages is Acehnese that is actively used as a communication purposes by its speakers in the province of Aceh (Zulfadli, 2014). Acehnese is known as a language spoken by the Acehnese tribe in coastal areas, some in the rural areas, and the others in the inland areas of Aceh (McCulloch, 2005). Acehnese is classified as Austronesian language that is utilized in the part of the northwest of Indonesia (Mustafa, 2022). It is spoken daily by a large number of speakers about 3.5 million (Lewis, 2009). Additionally, the province in which this language exists is settled by 2,727,050 male populations and 2,732,064 female populations (the Bureau of Statistics of Aceh Province, 2021). The clear and absolute evidence is obtained that about 70% of Acehnese speakers are proud to still use their language until the present day.

The history of the Acehnese is known unique and interesting for people who do not speak this language. In this lovely country, Indonesia, any of us could possibly find out and understand that Malay and Minangkabau are closely similar in sound to Acehnese (Nucifera, 2018). This argument is strongly reasonable if we dig the history of these languages at which part they share the similarities. In a book written by Durie (1985) explained more the reason of the close relation between Acehnese and Chamic language. He also mentioned a proto-Chamic and phonological study by Lee (1966) that demonstrated the Chamic took place in Austronesian. However in this study, Lee did not show the language relation of Acehnese, Niemann (1981), otherwise, found out similarities between Acehnese and Chamic in their morphological and lexical feature.

Some of the local languages in Indonesia belong to the family of Chamic language or Malayo-Chamic such as Acehnese, Banjarese, Batin, Kendayan Dayak, Keninjal, Kubu, Loncong,

Minangkabau, Muko-Muko, Pekal, Selako, Seraway, and many others from Vietnam and Malaysia (Blust, 2009). Nucifera (2018: 16) added that these ethnical languages are related because of the Chamic derivation; in this case, Acehnese, Malay, and Minangkabau. Aziz, Amery and Mustafa (2023) additionally claimed that another aspect shared by Malay language is the words that the Acehnese borrowed.

As the Austronesian language, Acehnese, Alas, and Gayonese are classified into the western Austronesian languages (Keraf, 1996 in Rizki & Junaidi, 2020). According to Muhammad & Hendrokumoro (2022a; 2022b), within the languages in Aceh, the Acehnese has some correspondences in phonemic features with Gayonese, Devayan language, Sigulai language, and Jamèe language. Furthermore, it is undeniable that Acehnese has been spread and spoken all over Aceh, although its speakers share their province with other ethnical language group (Durie, 1985). In the west Aceh, Acehnese speakers from the north and Minangkabau speakers from the south live in close proximity, particularly in southward of Meulaboh. Durie (1985) continued that this group is known as *aneuk jamèe* 'children of strangers'. Then, in the south of Aceh has been inhabited by small group known as Kluet who use the language that is related to Alas and Karo. Meanwhile, the part of Aceh in east has shared the area to the speakers of *basa Teumieng* in Tamiang which Durie assured is the variety of Malay. In addition, these all groups of speaker are ethnically Muslim people (Durie, 1985).

It was found the contradictory between linguists who described the population settle down in Aceh. Wu (2006) divided them into eight significant ethnic groups that are Acehnese, Gayonese, Alas, Tamiang, Simeulu, Ulu Singkil, Aneuk Jamèe, and Kluet. Meanwhile, MvCulloch (2005) had classified Acehnese people into two groups of ethnic i.e. Acehnese, Gayonese, Alas, and Tamiang are main ethnic among others mentioned by Wu, and the others are Ulu Singkil, Kluet, Aneuk Jamèe, and Simeulu included in smaller ethnic. He continued that both groups have their distinctive language or dialect. Furthermore, Taylor (2011) suggested another category for the Minangkabau, Javanese, and Chinese as the minorities in Aceh.

Based on the previous elaboration on ethnic spoken language in Aceh, with the highest percentage users, Acehnese is evidently the language mostly used in Aceh. Due to the reason of environment or geographical aspect where the Acehnese people live their life side to side with now possibly claimed as other Acehnese ethnic. It seems to have differences in the way of the speakers perform the language, Acehnese in specific. In accordance with Wildan (2002), Aceh is home to nine distinct local languages which are spoken in the region i.e. Acehnese, Alas, Gayo, Tamiang, Aneuk Jamèe, and Kluet (in Yusuf 2013: 2).

Acehnese is composed of four primary dialects that are spoken in a number of different regencies (Asyik, 1987; Cowan, 2009; Nazar, Sibarani, Nadra & Hanafiah, 2017). How the Acehnese is spoken differently has become the reference by Asyik (1987: 3) to elaborate the major dialect and it depends on the district in which speakers are located. The distribution is as follows:

1. The Aceh Besar or the Greater Aceh dialect, spoken in the regency of Aceh Besar and Banda Aceh
2. The Pidie dialect, spoken by speakers in two areas surrounding Pidie and Pidie Jaya Regency
3. The North Aceh dialect, spoken in the districts of North Aceh, East Aceh, Bireuen Regencies (Yusuf, 2013)
4. The West Aceh dialect, spoken in Meulaboh which is located in the West Aceh Regency, in South East Regency, (Yusuf, 2013) spoken as well in the Aceh Jaya and Nagan Raya Regencies

It was ever recorded that the form the North Aceh dialect is the standard for Acehnese and even after 200 kilometers, the dialect tend to be constant in its structure and a multitude of speakers

(Asyik, 1987; Durie, 1985; Yusuf, 2013; Masykar, Almulhim & Nurrahmi, 2021). Within the Grater Aceh dialect environment, its speakers produce words in several differences that cause sub-dialects. In Asyik (1987: 4), it was explained that specifically for the areas make production of [a] varies, such as, mata 'eye' and tika 'mat' are pronounced [matə] and [tikə] and other variation.

Although the dialect of North Aceh is the most persistent and the most used dialect in Aceh, there are also numbers of speaker of Pidie dialect that make it as the second-most prevalent among other major dialects (Durie, 1985: 6). Moreover, dialectical use of Acehnese in Pidie has fewer dialectal differences than the Greater Aceh dialect (Asyik, 1987). In short, each of Acehnese dialects has a distinctive pronunciation of vowel sounds, yet there are also similarities. For example, in word beukah 'broken', the sound [eu] is pronounced by Pidienese speakers as [bʉkah], whereas in other dialects it is pronounced as [bukah]. In contrast to other dialects, the Pidie dialect forms the sound [u] as [ɯ], as in the phrases rukok 'cigarette' and rugoe loss are pronounced with [rɯkok] and [rɯge].

There are found several studies discussing the Acehnese vowels issue. There are some of those who had discussed the Acehnese oral monophthong vowels with various dialects selected (e.g. Durie, 1985; Asyik, 1987; Pillai & Yusuf, 2012; Yusuf, 2013; Yusuf & Pillai, 2013, 2016; Yusuf, Fata & Aulia, 2017; Masykar, Almulhim & Nurrahmi, 2021; Yusuf et.al., 2022). However, in Yusuf (2013), there was also mentioned the elaboration of the Acehnese diphthongs produced by Acehnese and Kampung Aceh in Keudah "language consultants". Furthermore, studies on the diphthong vowel of Acehnese were done by some researchers (e.g. Asyik, 1987; Nucifera, 2018; Masykar, Almulhim & Nurrahmi, 2021). A recent study that was conducted by Masykar, Almulhim & Nurrahmi in 2021, the Acehnese monophthong vowels are some remain the same as it is in the production. Surprisingly, the speakers of Samatiga dialect that is the subdistrict of Aceh Barat they chose as the scope of the research produce the monophthong of /ɔ/ and /ɛ/ as diphthong. The /ɔ/, back vowel, in [cok] "take" was produced similarly as /au/ in [mano]"take a bath"; whilst the /ɛ/, front vowel, in [cèt] "paint" was closely produced as /ai/ in [bajè] "cloth".

There are ten oral monophthong vowels that have been reported in some previous studies done by Asyik (1987), Durie (1985), and Pillai and Yusuf (2012). The ten vowels of oral monophthongs are distributed in some parts of vocal tract; front vowel, mid-high vowel, mid-low vowel, and back vowel. This distribution can be seen in the following table.

Tabel 1. Acehnese Oral Monophthong Vowels (Reproduced from Asyik, 1987)

High	i	ɯ	u
Mid-High	e	ə	o
Mid-Low	ɛ	ʌ	ɔ
Low		a	

Particularly, in a study done by Al-Harbi (2003) on the Pidienese speakers who were studying in Saudi Arabia when this study conducted, the inventory of monophthongs is presented similarly to Asyik's. He mentioned that the vowel /ʌ/ as back vowel is closer to /ɔ/ in the production. Whereas, in the table, it is described that the vowel /ʌ/ as central mid-low vowel by Asyik (1987: 17) and Durie (1985: 16). Besides, in Durie's (1985) vowel inventory was not reported the vowel /ə/ because he declared that unstressed /ɯ/ is mostly the same pronounced as /ə/.

Diphthong is the way to pronounce word with two sounds. For example, a word *bajoe* [badʒɔə] "steel" started with /ɔ/ and ended with /ə/. The change of sound happens at glance or in other word it pronounced in really short time. Diphthongs end with /ə/ seems difficult to pronounce by non-native speakers who do not have this kind of diphthongs. There are differences in the description given by some researcher towards Acehnese diphthong. Mahmud (2014, in

Nucifera, 2018) stated that diphthong in Acehnese comprises three kind of them which end with /ə/, /i/, and /u/. For example, diphthong /eu/ in word *jeut* [dʒeut] "can or able" comprises of vowel /e/ and /u/ that is produced alternately. However, in Asyik's (1987) and Durie's (1985) inventories on diphthong, /eu/ is classified into monophthong /ɯ/.

Asyik (1987) has invented two types of diphthong in Acehnese i.e. ending with /ə/ and ending with /i/. While, Pillai and Yusuf (2012) also categorized the Acehnese diphthongs into two types i.e. rising diphthong and centering diphthong. In line with the naming of diphthong types, they mentioned that Clark & Yallop (1995) divided diphthong into closing and centering. Here is the diphthong presented by Pillai and Yusuf (2012) that was reproduced from Asyik's inventory.

Tabel 2. Acehnese Oral Diphthongs

Diphthongs ending with /ə/ (centering diphthong)		
/iə/	/ɯə/	/uə/
/ɛə/	/ʌə/	/ɔə/

Diphthongs ending with /i/ (rising diphthong)	
	/ui/
/əi/	/oi/
/ʌi/	/ɔi/
/ai/	

Based on the elaboration of the Acehnese studies that were conducted by some authors, this recent study has an interest to investigate and discuss how the Acehnese speakers who speak with Pidie dialect produce oral diphthong, particularly the rising diphthongs or those which ends with /i/.

METHOD

Ten language consultants, male and female, were selected as the subject of this study. The selection of different gender is considered for the fulfillment for each gender in Acehnese rising diphthongs production. The result will obviously not the same because sex differentiate the vowel value. This is due to the difference of the vocal tract length between male and female. Maragakis (2008, in Yusuf, 2013) defined that the vocal tract of man is over 18 cm, whilst female vocal tract is around 13 cm. In regarding, women have short vocal tract than man have, hence, the resonance frequancies of women is higher than man (Flynn, 2011)Both of them are the newcomer in Banda Aceh as the first year university students who are studying there. The age of language consultants are 19-20 years old. They are from Sigli, the capital of Pidie Regency. Then, the criteria they fulfill become the reason for the author to ask them in assisting this study successful. The criteria are suggested by Yusuf et.al (2017) such as Acehnese speaker with Pidie dialect used in daily conversation, short vacation is exception rather than living outside of the residence during their lifetime, have no dental problem and lips deformities, and have no problem with the hearing system. While, six oral diphthong vowels of Acehnese are the object in this current study.

Six proposed Acehnese words consisting diphthong vowels (see Appendix 1) were elicited by the language consultants. These word lists were adopted from Yusuf (2013) because Pidie dialect consist and use these words as well. The informants were asked to insert each prepared word that contains diphthong vowels into the blank space within the carrier sentence *"Ucap …. sigö teuk"* [say … one more time]. There were six times repetitions for each word. Total token obtained was about 360 tokens to gain the average measurement when they are converted into

excel. Carrier sentence is also implemented in some previous studies (e.g. King, 2006; Verhoeven & Bael, 2002; Yusuf, 2013; Yusuf, Fata, & Aulia, 2017; Yusuf et. al., 2022) as a way to pursue the natural of speech. This method is done to avoid informants pretend stability of and control the voice. The rising diphthongs is set for the scope in this study that occur in words containing an open CV syllable with a stop consonant C. Audio recording is a tool used to record the words elicited by the informants. The format of audio must be in WAV file in order to be compatible in Praat software version 6.4.07. Praat software gave a big support in this study because the raw data were analyzed firstly in it. First, the data obtained in form of recording speech were transferred into Praat software (Boersma & Weenink, 2023). Due to the moving of the vowel quality making the sound of diphthong does not remain stable (Ladefoged, 2006). This is why Rate of Change (ROC) suggested by Gay (1968) was implemented to measure F1 or first formant with the use of specific manner of measuring. Ken and Read (1992, in Yusuf, 2013) also gave suggestion to use ROC in describing diphthong. In Mayr and Davies (2011), they made measurement of Welsh diphthong for both F1 and F2 frequencies by dividing the length of the sound in trajectory into some points such as at 20%, 35%, 50%, 65%, and 80%. Other types of measuring diphthong were demonstrated by Deterding (2000) and Salbrina (2006); they took measurements of the vowel at both its start and end points.. Meanwhile, Tsukada (2008) and Yusuf (2013) chose to set 20% onset and 80% offset to measure diphthongs in order to avoid   the surrounding sound that might "adjoining sounds". However, this study decided to measure F1 and F2 at the onset 10% and the offset 90%. All of the measurements in Praat were scaled in Hertz as shown in the following figure as a sample of diphthong measurement.
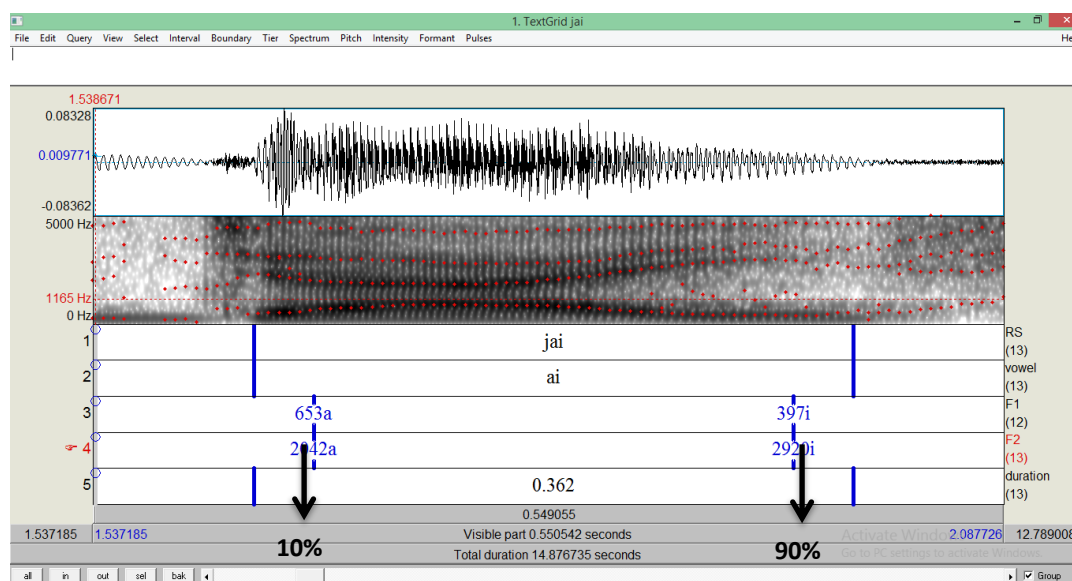

Figure 1. Diphthong Measurement Sample of Pidienese Speaker

To see the value of ROC, the study adopted the formula reproduced by Yusuf (2013) as bellows:

$$F1end - F1onset/duration\ in\ seconds =\ ROC\ (Hz/s)$$

The diphthong measurement of ROC values needs the duration of the targeted words. Furthermore, when the data were successfully measured in Praat, it needs to plot the language consultants' diphthong trajectories to better visualize. A Microsoft Excel vowel chart, vocal

track visualization, is ideally suited for creating a graphical depiction of a diphthong track. Yusuf (2013) said that the movement illustration of diphthongs can be realized with the use of their trajectory in vowel space. Hence, The primary feature for visually representing diphthong vowels is the mean F1 and F2 value in the Bark scale for each onset and offset.

RESULTS AND DISCUSSION

Results

This study aimed the rising diphthong (Yusuf, 2013) or diphthongs end with /i/ (Asyik, 1987); such as /ai/, /ɔi/, /ʌi/, /oi/, /əi/, and /ui/. From both gender of language consultants, there are 360 total tokens analyzed. After each of them had repeated the target words a total of six times, the values of ROC for F1 and F2 were calculated with 10% onset and offset. The following appearances are the result of the average F1 and F2 ROC values and two set of Pidienese speakers' vowel trajectories.

Table 1. F1 and F2 ROC Average Values for Male Rising Diphthong

Diphthongs	Extracted from the word	F1 ROC (Hz)	F2 ROC (Hz)
ui	*bui*	-281	7660
əi	*hei*	-485	4378
oi	*bhôi*	-266	6236
ʌi	*lagöina*	-396	6476
ɔi	*poih*	-63	5869
ai	*jai*	-526	1277

The values appeared in Table 3 were visualized in the following vowel space as a way to capture the diphthongs trajectories elicited by male speakers from Pidie.
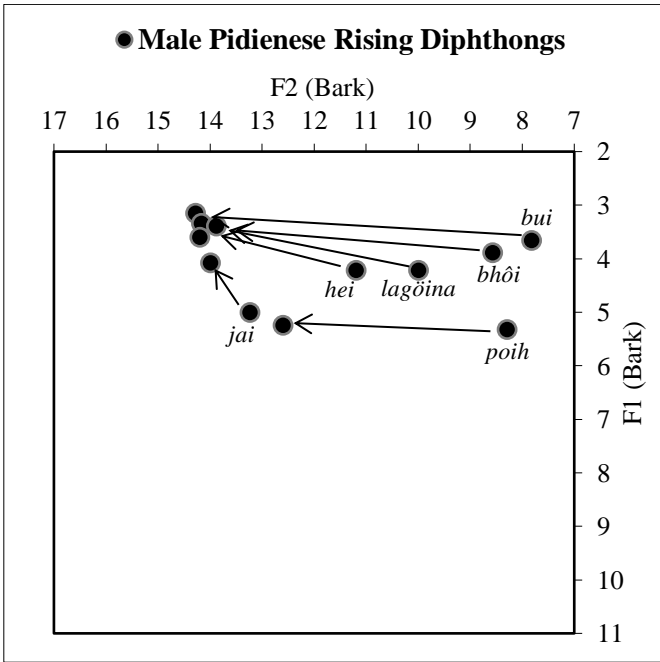
Figure 2. Acehnese Rising Diphthongs Movement
from Male Pidienese Language Consultants

Then, it is followed by the result of female Pidienese speakers F1 and F2 ROC for the six diphthongs.

Table 2: F1 and F2 ROC Average Values for Female Rising Diphthong

Diphthongs	Extracted from the word	F1 ROC (Hz/sec)	F2 ROC (Hz/sec)
ui	*bui*	-443	8488
əi	*hei*	-845	5194
oi	*bhôi*	-46	6692
ʌi	*lagöina*	-111	8661
ɔi	*poih*	-540	9087
ai	*jai*	-477	2085

In order to represent the trajectory of the diphthongs elicited by female speakers from Pidie, the values shown in Table 4 were visualised in the subsequent vowel space.
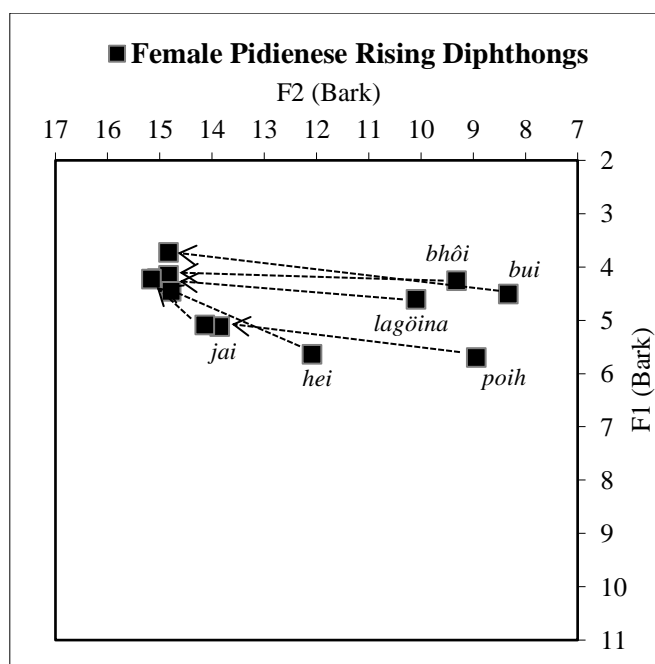

Figure 3. Acehnese Rising Diphthongs Movement
from Female Pidienese Language Consultants

Discussion

There are about 180 tokens from male speakers were measured for the six diphthongs ending with /i/. In Table 3, it displays the average values of F1 and F2 ROC for each diphthong that ends with /i/ by male speakers. Pillai and Yusuf (2012) explained the minimal average F1 and F2 ROC values for a vowel suggest that there is little motion from its onset to its offset. It is conversely to the big average values in F1 and F2 ROC as in /ai/ values that indicate the rising

of vowel is obviously seem in the vowel space. Then, the indication of positive average F1 ROC value is for a downward trajectory, when vowel F1 ROC values demonstrate a negative average, this indicates an upward trajectory. Further, the presence of positive values in the average F2 ROC indicates that the vowel is progressing towards the front part of the vowel space. Otherwise, the negative values in the average F2 ROC indicate that the vowel is positioned towards the back part of the vowel space as captured in Figure 2.

The smallest average F1 ROC values is /ɔi/ in *poih* which implies this diphthong exhibits a deficiency in the alteration of vowel height. Besides, the offset of /ɔi/ should be higher and located near to other offsets but it appears more back or in the center of the vowel space. Hence, /ɔi/ in the word *poih* seems closer to /ɔe/ if it is compared the /e/ to the production of Pidienese speaker in Durie (1985). As the highest average F1 ROC value, /ai/ in the word *jai* exhibits a clear rising movement but it is short due to its small average F2 ROC value. Meanwhile, the F1 and F2 ROC average values for /ui/, /əi/, /oi/, and /ʌi/ indicate that their movement is large correlated to the big value they have. However, the beginning /ʌi/ is located differently compared to Durie's (1985) and Al-Harbi's (2003) Pidie dialect descriptions of /ʌ/ that is in the center of the vowel space. In this finding, /ʌi/ in *lagöina* is slightly produced as /oi/.

Another 180 tokens were assessed for the remaining six oral diphthongs that ends with /i/ from female language consultants. In Table 4, it presents the average values of F1 and F2 ROC for each rising diphthong. The high mean F1 ROC value seen for the /əi/ suggests a more pronounced formant displacement in terms of vowel height when compared to the other distinctive vowels. Conversely, the low mean F1 ROC values observed for the /oi/ show little shift in vowel height. The F2 ROC values for all vowels exhibit a consistent pattern of back to front trajectory, as depicted in Figure 4. However, /ai/ in the word *jai* exhibits a brief transition from the beginning to the end. Whilst, the small average F1 ROC value for /oi/ in the word bhôi indicates a lack of change in the vowel height. The production of /ɔi/ in poih appears moving closer to /ɔe/ in which /e/ is located below the /i/ (Durie, 1985; Pillai & Yusuf 2012; Yusuf et. al., 2022). Even though the onset and offset of /ʌi/ presenting a great movement but the scatter plot shows that this diphthong is somewhat produced close to /oi/ by considering the vowel placement by Asyik (1987) and Durie (1985) that /ʌ/ as a low-mid vowel is below the /o/ and /ə/ as the high-mid vowels.

CONCLUSION

Generally, this paper contributes to the existing body of knowledge on Acehnese vowels description by conducting an acoustic analysis of the diphthongs in two set of speakers of Acehnese. In doing so, it presents the newest finding of the Acehnese vowel production especially for the diphthongs. The male and female speakers will not give the same quality in vowel production due to the length of vocal tract but they could performed great movement of the Acehnese diphthongs. The acoustic analysis of the diphthongs represent that males' trajectories of diphthongs are realized a little more back and lower than the trajectories of females. Somehow, both gender once violates two diphthongs characteristic described by Asyik (1987) and Durie (1985). For example, a rising trajectory diphthong, /ɔi/ in *poih*, its offset in the vowel space shifts towards the center. indicating that the speakers perform it differently. Another example is the /ʌi/ in *lagöina* which its onset was realized to be more pronounced as /o/ as seen in prior figures. This phenomenon could possibly implicate the mispronunciation aspect happened toward speakers (Aini, Pahlevi, and Wahyuna, 2024) when the word is barely used to pursue the meaning behind it. There is a possibility that they tend to use other words to express meaning of *lagöina*. Yet, this may be the age of speakers that causes a different finding which becomes a new description of Pidie dialect based on speakers ages. While the ROC

measurements indicate certain variations in the manner in which male and female Pidie speakers produce Acehnese diphthongs, additional research is required, including the selection of older age groups, to determine whether Pidie speakers possess diphthong characteristics similar to those identified in the present study. Moreover, the Acehnese language has another type of oral diphthongs that could be further research that is the centering diphthongs or those vowels which ends with /ə/.

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