

SPECTROGRAPHIC ANALYSIS OF EWE VOWELS

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DEDICATION

I dedicate this thesis to my God the Almighty Jehovah for granting me life during the period of writing, to the memory of Papagɛtɔ, my late Father. It also goes to all the great linguists of Ghana who have worked tirelessly to see to it that our Ghanaian languages stand up to other languages of the world.

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Abstract

This thesis is a study of dialectal variation in the production of the vowels of five dialects of Ewe a Kwa language in West Africa. The study provides the description of formant frequencies of vowels. In all, the vowels as produced by 44 speakers comprising of 24 males and 20 females were measured. Some statistical analyses were carried out to ascertain acoustic differences that exist between the productions of vowels of the dialects studied. There were differences between the dialects, which occurred mostly with the mid-front vowels, and the supposed central vowel. It is clear that the different dialects studied, even though they share some characteristics do not use the same qualities of vowels nor do they use the same number of vowels. Some of the vowels are therefore grouped in this study and from these groups the various dialects select their vowel inventory. This study suggests that the vowels [e], [ɛ], [ə] and their nasalized counterparts, as constitute one group. Their choice and use depends on the dialects. [a] and [ɔ] stand separately as low-back and mid-back vowels and their nasals as low close to back and mid-back vowels respectively. [u] and [o] also stand as independent back vowels. However their nasalized versions are a little shifted from the back toward the center.

CHAPTER ONE

One of the objectives of any science is to be able to measure the things that are being described, so that they can be expressed in terms of valid, reliable, and significant numbers. A valid number is one that truly measures the thing that you say you are measuring....Ladefoged (1982:170)

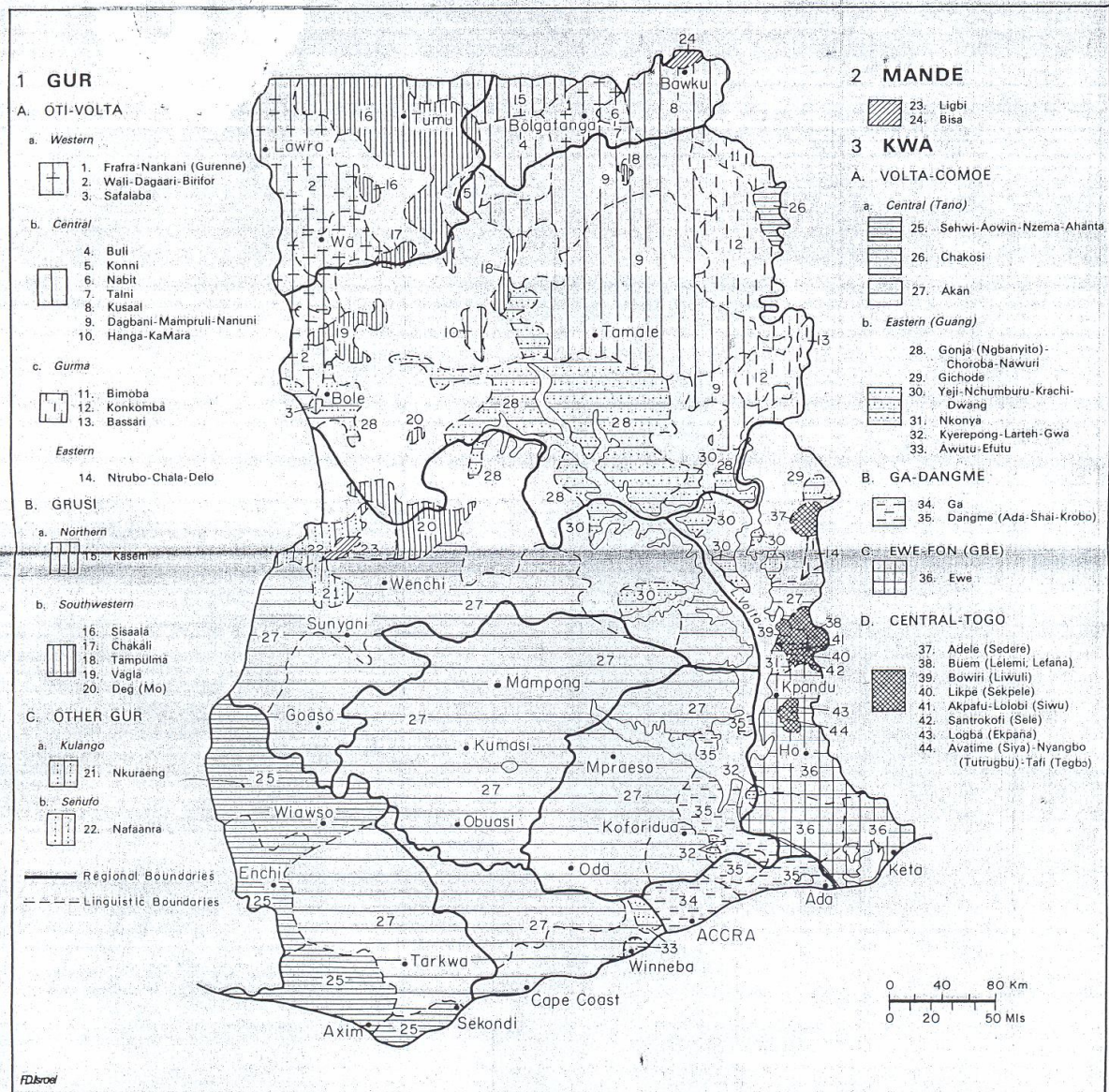
INTRODUCTION

The Ewe Language is of the Kwa family of languages spoken in some regions of Ghana, Togo, Benin and Nigeria in West Africa (Refer to page 2). The language consists of many dialects, which are distinct in terms of accent. Some of the dialects of Ewe in Ghana are Aɲɔ, Vedome (Kpando, Ho, Peki etc), Tɔŋu (Mafi, Bator, Agave etc) and Avenor to name but just a few. Ewe is not used as a lingua franca except by speakers of Central Togo languages like Avatime, Lelemi etc (Duthie 1988). However, the language is used in all activities of the native speakers, be it commercial, social or cultural.

For many years Ewe Language users have described the Ewe vowels as being uniform irrespective of the dialect. Any accent or sound variation is thought to be a well-described socio-stylistics continuum within their individual environments and therefore is not

considered significant. A few authors (Ansre 2000, Hounkpati 1991, Stahlke 1971) have however made impressionistic observations about regional or dialectal differences in the vowel system of Ewe. Apart from these phonological descriptions, the vowels have not been acoustically documented. For the Ewes, the differences in sounds do not matter so far as they are able to communicate effectively. However, it must be noted that a claim of uniformity underplays the very real and socially vital nature of linguistics differentiation (Co

LANGUAGE MAP OF GHANA



Adapted from Map of Ghanaian Languages by Language Centre, Legon and Ghana Institute of Linguistics, 1980
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phonetic evidence by spectrographic analysis, which will help to classify the quality of the vowels as uniquely produced by these various speakers. This will provide the

language student and the linguist with information about the salient acoustic properties of the vowels produced by these dialects.

Some questions that this study attempts to answer are:

What factors determine vowel quality in Ewe? Does dialectal difference have any effect on vowels quality in Ewe? The study aims at answering these questions and others that may crop up in the course of the study.

All human languages select from the human articulatory potentials, the various articulatory gestures and processes they need to generate and produce speech sounds. In consequence individual languages (and dialects) are normative, in the sense that speakers operate within the limits imposed by the human articulatory potentials (Yallop and Clark 1991: 116). Even though it may not be obligatory for a language or dialect to select from the norms, speakers show their response to the normativity, sometimes “informally” or “subconsciously” when they recognize a familiar regional dialect and when they realize that they cannot pronounce a foreign word or sound. That is to say, whether or not a language chooses to contrast sounds along a particular parameter is very much a language specific and must be explained in the sound system of that language. Speakers of Ewe, even though they all operate within the norms of the production of sounds in general, have in fact, a significant number of variations in their pronunciation. This is because they are from diverse cultural and social backgrounds.

Language educators need to know what are typical examples of vowel sounds produced by different individuals. They also need to know how much variation is there between speakers of languages and what are the sources of these variations, whether they are due to individual physiological make-up, the individual’s way of speaking, the group or dialectal differences. This is important because the teacher of language must be able to “diagnose the pronunciation errors made by his students, and device means of correcting them” (Catford 1988). Understanding of phonetic variations is important not only in linguistic or language teaching and learning but is also useful in the development of speech technological applications that have to be able to cope with individual differences in accent and style. It is therefore assumed here that there are at least some phonetic variations in the vowel production of the various dialects of Ewe. This study therefore seeks to investigate the variations that may exist between the mentioned dialects of the Ewe language.

1.2 The Need for Acoustic Analysis of the Ewe Vowels

Previous descriptions of the Ewe vowels have been based mostly on auditory perceptions of linguists. However, the linguistic disadvantage of this is that, it is to some degree impressionistic: the observer must be well trained in phonetics, even then, he can be influenced by conventional terminology and by linguistic experience. There is also the risk of personal bias shaped by the linguist’s own native language. The impressionistic reports, which continue to dominate work on phonological variation, can also be fraught with problems including influence of categorical perception and a failure to use the appropriate phonetic symbols. When discussing the issue of the disadvantages that may

occur in the use of the impressionistic approach to phonetic study, Foulkes and Dochery (1999), noted “it is not always possible, for example, to determine impressionistically whether a word-final voiceless stop such as / t/ is released or not”. Knowing what exactly is happening in a linguistic phenomenon is very necessary. Therefore one may say that instrumental phonetic research is very important to authenticating the generalizations based on impressionistic studies of language variation.

The tongue arching or curving method of determining vowel quality has been used since the mid-nineteenth century and still being used but it has been noted that this model of vowel description is not sufficient in determining vowel quality. Godinez (1978) cited Wood’s (1975) extensive study of published x-ray tracings of many languages as an example. It notices that, a number of articulatory positions ascribed to particular vowels by the tongue-arching model are in error. For instance, the tongue height of the Spanish vowel [o] is found to lie below that of the vowel [ɔ] contrary to the description provided by the tongue-arching model. Godinez observed that the tongue-arching model of vowel descriptions is not adequate for the descriptions of actual articulatory parameters involved in vowel production.

Citing Chen (1973), Disner (1978:10) note that a linguistic study of phonetic detail in language must be undertaken “with the view of extracting from the language specific variations the universal norms governing the rules that operate in individual languages.” She explained that if we do not *have a firmer grip on phonetic reality*, talking about rule naturalness would be *nothing more than an impressionistic recording of trends* that exist in languages. Anderson (1980) cited Donegan and Stampe (1979: 126) that “sound patterns of languages...are governed by forces implicit in human vocalization and perception”. That assumption, in their opinion leads to a natural theory in that it presents language (specially the phonological aspect of language) as a natural reflection of the needs, capabilities, and world of its users. Natural phonology means everything that language owes is to the fact that it is spoken (Anderson, 1980: 127-128). Anderson however suggests that the “*psychological reality* of a phonological description ought *necessarily* to be susceptible to confirmation through experimental tests involving psychological tasks” which are not related to knowledge and use of the language only.

Linguists, by far have noticed that even though descriptions of sound patterns “within” languages can be stated in phonological terms and if they would be explanatory, in articulatory terms, is not enough for specifying or classifying the actual sounds of a language. That is to say that the relationship between phonological features and phonetic scales is complicated. Lindau (1980) conducted a study to this effect. Her intention was to discuss some phonetic differences between several Nigerian languages and examine one particular kind of relationship that may occur between features and their phonetic correlates. The sound classes of rhotics, implosives, and vowels were considered. Speakers of Izon, Kalabari, Ijo, Degema, Buno and Hausa, all of which are Nigeria languages were recorded saying words illustrating the relevant sounds in a frame. In all, 43 speakers recorded 129 tokens. The r-sounds in the language samples were analyzed from wide band sound spectrograms and presented. Oscillomink tracings of intensity and sound wave of words with bilabial plosive and implosives were also collected and

presented in figures. The results indicated that the languages, even though have the same vowel systems, have distinct acoustic-phonetic features. For instance, all the languages investigated used the /r/ phoneme but whilst some realized it as a trill or a tap, others realized it as an approximant. She concluded among other things that, “...it will be a futile task for us to search for the essence of a particular class of sounds in terms of a single phonetic correlate. Some features may just be a cover term for many related sounds”. This means that when phonological differences within a single language are being discussed, casual descriptions of the phonetic facts may be enough. However, when we are trying to compare languages or give accurate description of a single language, there is the need to reinterpret phonological oppositions in terms of complexes of the real phonetic elements of the languages. The purpose of this study therefore is to determine on a scientific basis the underlying phonetic parameters that characterize the vowels of Ewe as produced by speakers of the mentioned dialects and through spectrographic analysis. Spectrographic analysis can help us measure, analyze, and process what we hear so as to fully understand what happens in the human speech production mechanism. This understanding will help us fully grasp the differences that are manifested in the languages and dialects we speak and help us appreciate the uniqueness of those languages or dialects.

1.3 Features of Vowel Production

Phoneticians describe and classify the sounds of human language in terms of how they are produced by the vocal apparatus (Articulatory phonetics), the physical properties of the sound wave emanating from the speaker (Acoustic phonetics) and the effects the sound wave has on the ear (Auditory phonetics) Binkert (2003, p. 37).

Human speech is, from a technical point of view, the result of the airflow from the lungs through the vocal tract. The variability of the sounds that can be produced is caused by the level and type of the vocal tract movement involved. That is to say that the level and type of constriction of the airflow demanded by the various parts of the vocal tract, namely, the lips, the tongue or the vocal folds etc determines the nature of the sound that is produced. These parts which, are referred to as the articulators, play an important role in human speech production. Unlike consonants, vowels sounds are produced with relatively no obstruction of airstreams and this makes description of vowels difficult without the use of X-ray equipments (Apanglo-Nartey 2002:34). Understanding of the state of the human articulatory system is, in mechanical terms, the obvious manifestation of the human speech in the acoustic signal.

Traditionally, vowels are described using two fundamental articulatory features. These are the shape and position of the tongue, and the shape and degree of protrusion of the lips. In other words, the most useful description of vowel sounds is based on noting the highest position of the tongue as well as the position of the lips. Most of the time, it is the tongue that determines the size and shape of the oral and pharyngeal cavities. The lips on the other hand control the shape and area of the front and the length of the vocal tract. Based on these fundamental features, Cartford (1994) noted that “ vowels or more precisely, the mouth shape for vowels, are specified in terms of three parameters: vertical

tongue-position (high-low), horizontal tongue-position (front-back) and lip-position (unrounded-rounded).

All vowels are made by raising either the middle or the back of the tongue. The part of the tongue that is closest to the “roof of the mouth” when producing the vowels determines whether that vowel is front, central or back and the relative height of the tongue in the mouth in relation to the palate determines whether a vowel is high, mid, or low (Dolphyne 1988). To describe these features in the best way whatsoever, Ladefoged (1978) establishes that when doing a phonetic study of speech sounds, we need to consider things like “formant frequencies or parameterized vocal tract shapes.” He explains that one cannot be content with specifications of linguistic phenomena in terms of physical scales representing phonological features.

Phonological features are not sufficient for specifying the actual sounds of a language, nor are they in one to one relationship with minimal sets of parameters that are necessary and sufficient for specifying the actual sounds of a language. Ladefoged, Harshman, Goldstein and Rice (1977) discussed Seventeen parameters of vowel production, all of which lie in the domain of the two fundamental articulatory features in description of vowels. Two out of these, tongue front raising-lowering and back raising-lowering have been indicated as parameters that can be useful in identification of vowels. The two parameters are appropriate for phonologically accounting for “more of the variance” that may be found in languages. They show the degree of front raising and back raising in some English vowels and they found out that there is a similarity between their arrangement and that of the traditional vowels chart. However using phonological parameters alone to describe sounds may not be sufficient because sounds may appear the same but in reality, they are not. A case in view is Chomsky and Halle’s 1968 Sound patterns of English. The features they propose do not tell us the actual phonetic features of the sounds. We cannot tell if the sound represented by one phonological feature is the same as that represented by the same feature in another language.

For example, it has been noted by Ladefoged (1979) and Disner (1978:42) that the sound [i] as in English is not the same as in Danish even though both sounds have the same phonological representation. The Danish [i] is quite higher than that of English. Disner identified that the unrounded vowels of Danish are “unevenly” spaced, three of them being much higher than their English counterparts. We cannot nevertheless say that the Danes have a higher basis of articulation than the English because the differences are not seen in all the vowels. Ladefoged also referred to the case of the velar ejective [kʼ] that is written with the same symbol in Hausa and Navaho. Even though they both write and transcribe it in the same way, *they do not sound the same* in both languages. The Navaho speaker’s will sound totally foreign to the Hausa speakers. The implosives [ɓ, ɗ] in Hausa and Kalabari languages in Nigeria are also said to be totally different sounds in both languages when they were analyzed spectrographically, even though they are written with the same phonetic symbol. There should therefore be a thorough phonetic investigation to back any phonological claims that may be made about the sounds in question. Ladefoged put it this way, “In fact the whole concept of the base of articulation seems to me to be invariably inadequate for discussing differences between languages. I know of no quantified differences that can be handled in this way”. This means that he

agrees that when we are giving a precise account of what makes a particular language sound the way it does; it is necessary to describe the phonetic properties of individual segments. Describing the sounds with phonological features alone may be misleading. It is necessary then to conduct a thorough examination of the vowels of any language being studied before drawing a valid conclusion about them. Basing any claim on just an assumption will not be scientific.

In recent years the science of articulatory phonetics has been complemented by investigations into the physical properties of speech sounds. Research in acoustic phonetics has increased the knowledge of speech properties so dramatically that today sophisticated speech analysis equipments have been developed which break down speech into its important elements for analysis (Clark et al 1994, 314-315). Though this study is mainly based on the acoustic domain, the researcher is not claiming that, this domain is more appropriate than the others. This domain will attempt to relate the objective physical dimensions of the acoustic signal that will serve to help us define the perceptual qualities that distinguishes the vowels from each other.

1.4 The vowel system of Ewe

The Ewe vowel system phonetically, is varied and complex. Generally the vowel system of the Ewe language consists of eight standard vowels, [i, e, ε, ə, a, u, o, ɔ] and their nasalized counterparts. Ewe vowels can be classified as high front [i], high back [u], mid front [e, ε], and mid back [o, ɔ]. The position of these vowels, except [a] and [ə] are provided similarly in the various published literature on the Ewe vowels. In some cases [a] is described as central low vowel and [ə] as central mid vowel (Duthie 1996:19, Nyomi 1976) while in other cases [a] is described “as close to front low vowel and [ə] as close to back mid vowel” (Berry 1952). These qualities are mainly based on the articulatory impression, and in other cases, the tongue-arching model of vowel description. The phonetic inventory of the Ewe vowels as presented in some published literatures are as discussed below.

Houkpati (1991) presented the following:

i ĩ	u ũ
e ě	o ɔ̃
	ə ɛ̃
ε ɛ̃	ɔ ɔ̃
	a ǎ

Fig. 1.4.1 Phonetic inventory of Ewe Vowels as presented by Hounkpati (1991)

Hounkpati posits that Anɔ and Avenor dialects have [i, ɪ̃, e, ɛ̃, ə, ə̃, a, ǣ, u, ũ, o, ɔ, ɔ̃] in their vowel inventory while Avenor has an additional [ɛ̃]. Kpando on the other hand has [i, ɪ̃, e, ɛ̃, ɛ, ɛ̃, a, ǣ, u, ũ, o, ɔ, ɔ̃].

In terms of vowel height as he explains, [+high] implies [-low] and [+low] implies [-high] and two features [±high] and [±low] can be posited to differentiate three degrees of aperture. Even though [ɛ] and [ɔ] are functionally classified as having features [+low], “in strict phonetic terms, only [a] is a [+low] vowel in Gbe (Ewe)”. Similarly although [+front] means [-back] and [+back] means [-front], [±front] and [±back] can be posited to differentiate places of articulation so that [ə] and [a] become central vowels. Considering that all front vowels are redundantly unrounded while the back ones are redundantly rounded we can use [±back] and [±rounded] interchangeably for some vowels depending on the nature of the processes being discussed.

To Ansre (2000), the vowel system of Ewe consists of the following:

i	ɪ̃	ũ	u
e	ɛ̃	õ	o
	ə	ə̃	
ɛ	ɛ̃	ɔ	ɔ̃
	a	ǣ	

Fig. 1.4.2 The vowel inventory of the Ewe language presented by Ansre (2000)

Ansre noted that Ewe usually has seven oral and seven nasalized vowel phonemes. However, there is a pair of vowels that is [ə] and [ə̃] which are used more in the southern dialects of Ewe in place of [ɛ] and [ɛ̃]. In Vedome dialects, especially Peki and its neighboring dialects, [ɔ] is used in place of [õ] while [ə] and [ə̃] are in complementary distribution with [e] and [ɛ̃].

Stahlke (1971) reduces the inventory of vowel segments of Ewe at the systematic phonemic level to seven short oral vowels: [i, e, ɛ, a, ɔ, o and u] and their nasal counterparts. He claims that [e] has merged with [ɛ] in the Kpando dialect except in certain environments and that there are living alternations between [e] and [ɛ] in Kpando, and that they can therefore be considered variants of one underlying segment [e]. He thus presented the Kpando vowel system as consisting of: [i, e, a, ɔ, o, u].

Discussing the issue of the specification of vowel height, Stahlke noted that the binary features framework proposed by Chomsky and Halle (1968), that a vowel would have the feature [+high] when it is made with the tongue body raised above neutral position and [+low] when the tongue body is below neutral position is one of the “more controversial points” in how vowel height in the study of vowels should be treated. The controversy as he explains arises from the high-low feature system. This is because all languages of the world do not have the same vowel height. For example Ewe, and other Kwa languages especially those with seven-vowel system, however, have more than three vowel heights.

Mensah (1977:6) raises some issues concerning the differences in the vowels used by the Tɔŋu dialect of Ewe and that of Aŋɔ and some parts of Vedome. He claims that the Aŋɔ speakers of Ewe do not use the vowel [ɛ] and Kpando and Peki (Vedome dialects) do not use [e]. As regards quality, these vowels as used by Tɔŋu have the same attributes as ascribed to them in the literature on the vowels. Most of the time Tɔŋu and Aŋɔ use [e] while Vedome uses [ɛ]. Of the two southern dialects of Ewe, [e] occurs more in Aŋɔ than in Tɔŋu and in all cases in which [e] occurs in Aŋɔ, the corresponding vowel in Tɔŋu is [ɛ]. He concluded that *Tɔŋu is somehow closer to Vedome than Aŋɔ*. This means that so far as these vowels are concerned, there is no specific agreement as to how they are used by the dialects. However, we cannot draw a solid conclusion based on these issues because his research does not include any reliable measures.

1.5 Nasalized Vowels in Ewe

A nasalized vowel is the one produced with a lowering velum so that the air escapes through both the nose and the mouth. In many languages, vowels that are adjacent to nasal consonants are produced partially or fully through the nose.

As can be noted from the vowel inventories discussed, all the oral vowels have nasalized counterparts. However some writers think that there are other nasalized vowels in the Ewe vowel system in addition to nasalization of the oral vowels. Stahlke (1971:42) and Westermann (1930:1); Ansre (1961:7-8); Berry (1951) cited in Hounkpati (1991) identified [ɪ̃] and [ũ̃] also as nasalized vowels in Ewe. They claim that these vowels occur in Aŋɔ, Kpando and Peki dialects of Ewe. They however noted that they do not occur as underlying segments, but rather as variants of [i] and [u] before [m] (when /m/ is a syllabic consonant).

The number of nasalized vowels that may exist in languages is relative to that particular language or dialect. Dolphyne (1988) discussed the nasalization process in Akan, also a Kwa language in Ghana. She noted that there are five phonemic nasal vowels; [ĩ, ẽ, ã, ũ, ɔ̃] in Akan even though they are not indicated in the orthography. Where as all vowels in Ewe can be nasalized, [e, ɛ, o, ɔ] cannot be nasalized in Akan. However [ɛ̃] and [ɔ̃] are nasalized in Fante, a

dialect of Akan, when they occur before nasal consonants [m] and [n]. In the Asante dialect, as Dolphyne explains, [ɛ] and [ɔ] are only slightly nasalized before [m] where as in Akuapem [ɛ] is nasalized in a few words. Abakah (2002) posits that there is an additional nasalized vowel, [æ̃] in Fante.

In English for example vowels following nasal consonants are nasalized, but do not have any effect on meaning but nasalized vowels in Ewe are most of the time in complementary distribution with the oral ones. Nasalization in Ewe is however obligatory. That is to say nasal vowels in Ewe are phonemic in that words can differ only in whether a vowel is nasalized or not. In Ewe orthography, nasal vowels are marked with the tilde as follows: [ĩ], [ẽ], [ɛ̃],[ã], [ũ], [õ], and [ỹ]. Thus in Ewe one can find word pairs such as:

ta- wrap a cloth	tã – to swear
lo-crocodile	lõ- take off fire
dzi – sing	dzĩ – red
dze – salt	dzẽ - redish
vɔ – finish	v ỹ – sin
lu – millet	lũ - shave
he / ə /- pull	hẽ / ẽ / - redish

Even though all the dialects of Ewe represent the vowels they produce with the same phonetic symbol, *we cannot assume that they are necessarily the same and have the same quality* (Disner 1978: 7). It has been realized that whenever speakers of different regional dialects communicate, they may notice, among a number of differences, that some of the speech sounds they are using are different. The average Ewe language user will recognize a number of geographical variants of Ewe. These variants or dialects are relatively different from what is referred to as the standard Ewe.

The spectrographic analysis of the Ewe vowels is to present the individual vowel sounds as a pair of figures representing the frequencies in hertz of the two lowest formants, which are conventionally labeled **F1** and **F2**. This will ascertain the qualities of the vowels as produced by speakers of the various dialects under study and to finally see how the Ewe vowel system looks like at the phonetic level.