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| RESEARCH ARTICLE

The Emergence of a Low Back Vowel in Qassimi Arabic

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| ABSTRACT

This study investigates the phonemic vowel system of Qassimi Arabic (QA), a sub-variety of Najdi Arabic spoken in the Qassim region of Saudi Arabia. Previous descriptions of Najdi Arabic typically assume a vowel inventory of three short and five long vowels and treat certain vowel qualities—most notably the low back vowel [ɑ]—as contextually conditioned allophones rather than independent phonemes. These accounts are largely based on impressionistic description and have not been systematically evaluated for QA. Drawing on 157 elicited tokens produced by three native QA speakers, this study combines phonological diagnostics with acoustic measurements of vowel formants and duration, following established approaches to vowel analysis. The results support a vowel inventory of four short vowels (i, a, ɑ, u) and five long vowels (iː, eː, aː, uː, oː). Crucially, converging phonological and phonetic evidence shows that the low back vowel /ɑ/ functions as a phoneme distinct from /a/ in QA, challenging earlier analyses that treat [ɑ] as a conditioned allophone. Acoustic results further show that the low back vowel /ɑ/ is consistently separated from /a/ in the vowel space, supporting its phonemic status. More generally, short vowels occupy a relatively compact and partially overlapping vowel space, whereas long vowels exhibit clearer spectral separation and significantly longer duration. Together, these findings demonstrate that the vowel system of Qassimi Arabic cannot be fully captured by phonemic inventories proposed for Najdi Arabic as a whole . More broadly, the study underscores the importance of variety-specific, instrumentally grounded analysis in Arabic dialectology and contributes to ongoing discussions of phonemic contrast, allophony, and vowel system variation in Arabic.

| KEYWORDS

Qassimi Arabic, Najdi Arabic, vowel system, phonemic contrast, acoustic analysis.

| ARTICLE INFORMATION

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1. Introduction

Arabic is a Semitic language characterized by extensive dialectal variation across a wide geographic area, stretching from North Africa to the Arabian Peninsula (Owens, 2005; Versteegh, 2014). Arabic varieties are commonly classified on both historical and geographical grounds, with regional groupings such as Eastern and Western Arabic reflecting systematic linguistic differences (Kaye & Rosenhouse, 1997). While such classifications are useful, they can obscure fine-grained differences at the level of individual regional varieties, particularly in phonological systems.

Within the Arabian Peninsula, varieties grouped under the label Najdi Arabic are often treated as forming a relatively homogeneous group. Ingham (1994), however, argues that "Najdi Arabic" does not denote a single variety but rather a set of closely related yet distinct dialects. This observation motivates variety-specific studies that examine individual Najdi sub-varieties independently, rather than assuming a shared phonological or grammatical system. One domain in which broad generalizations are especially common is the vowel system, where descriptions of Najdi Arabic are frequently extrapolated to sub-varieties without direct empirical verification.

The present study focuses on Qassimi Arabic (QA), a Najdi sub-variety spoken in the Qassim region of central Saudi Arabia (Ingham, 1982). QA is primarily spoken in an inland region with relatively limited contact with other Arabic dialects, a factor argued to contribute to the preservation of local linguistic features (Holes, 2004). Previous work notes that QA exhibits several phonological characteristics that distinguish it from other Najdi varieties (Prochazka, 1988), including aspects of its consonant system and syllable structure, suggesting that it may not fully conform to descriptions proposed for Najdi Arabic as a whole.

Among the phonological properties that have attracted attention in Najdi varieties are processes such as glottal stop weakening and alternations between velar stops and alveolar affricates (Prochazka, 1988). While QA shares many consonantal properties with other Najdi varieties, its vowel system has not been examined in comparable detail. Descriptions of Najdi Arabic generally posit a vowel inventory consisting of three short vowels and five long vowels, often treating additional vowel qualities as contextually conditioned allophones. Whether this canonical Najdi analysis accurately captures the vowel system of QA remains an open question.

This study addresses this gap by providing a focused analysis of the phonemic vowel system of Qassimi Arabic. Specifically, it investigates the status and phonetic realization of QA vowels by combining phonological diagnostics (minimal pairs, morphological alternations, and distributional patterns) with acoustic measurements of vowel formants and duration. By examining QA independently, the study evaluates whether its vowel system conforms to the canonical Najdi inventory or exhibits additional phonemic distinctions, such as a contrast between low front and low back vowels. The goal is not to offer a general description of Najdi Arabic, but rather to contribute a detailed, empirically grounded account of a single Najdi sub-variety, thereby enriching our understanding of phonological variation within Arabic.

2. Literature Review

Research on the vowel system of Najdi Arabic, including varieties spoken in the Qassim region, has produced long-standing disagreement regarding both the phonemic inventory and the phonological status of vowel variation. Since the late 1960s, studies have differed in their interpretation of vowel alternations, particularly with respect to the number of short vowels, the role of consonantal conditioning, and the distinction between phonemic contrast and allophonic realization.

A central point of debate concerns the number of phonemic short vowels in Najdi Arabic. Lehn (1967), based on data from Riyadh, Shaqra, and Unaizah, argued that Najdi varieties share a common vowel inventory with only two short vowel phonemes, /i/ and /a/. Under this analysis, surface variation—such as [i], [u], and [ɨ] for /i/, or [a], [ä], and [ɑ] for /a/—is treated as environmentally conditioned, particularly by the presence of emphatic or pharyngeal consonants. From this perspective, vowel alternations do not motivate additional phonemic distinctions.

In contrast, Johnstone (1967), working specifically on the Unaizah dialect, proposed a three-short-vowel system consisting of /i/, /a/, and /u/. While Johnstone likewise treated much vowel variation as allophonic, he diverged from Lehn by recognizing /u/ as an independent phoneme rather than a contextual realization of /i/. This difference is particularly relevant for Qassimi Arabic, given Unaizah's location within the Qassim region. However, even in Johnstone's analysis, the phonemic status of low back vowel qualities such as [ɑ] remained unresolved, as these were still attributed to emphatic environments.

A second area of disagreement involves the phonological interpretation of vowel realization patterns. Lehn's analysis emphasized extensive environment-driven variation, including backing, centralization, and glide formation, while maintaining a relatively abstract phonemic system. Johnstone, by contrast, reported fewer conditioned realizations for long vowels and treated vowels such as /e:/, /o:/, and /u:/ as largely stable across environments. This contrast highlights early uncertainty regarding how much phonetic detail should be encoded in phonemic representations.

Later work on Qassimi Arabic by Prochazka (1988) further complicated the picture. Although Prochazka accepted a three-short- and five-long-vowel inventory, aligning with Johnstone's phonemic analysis, he rejected many of the environment-specific realizations proposed in earlier work. In particular, Prochazka argued that short vowels such as /a/ and /u/ surface consistently as [a] and [u], regardless of consonantal context. At the same time, he proposed that /i/ may be realized as [u] in labial and emphatic environments (e.g. /ʔibuw/ → [ʔubuw] 'father'), suggesting a degree of vowel backing that exceeds earlier accounts.

A third unresolved issue concerns whether vowel variation in Najdi Arabic is strictly conditioned or partly free and contrastive. Ingham (1994) documented apparent free variation between [i] and [u] in forms such as [mitʕar] ~ [mutʕar] 'rain' and [kill] ~ [kull] 'all', raising questions about the predictability of vowel quality. Ingham also noted that short vowels /i/ and /u/ may be neutralized toward a schwa-like quality in the environment of pharyngeal and uvular consonants, while /a/ may exhibit increased closure in similar contexts. These observations blur the boundary between phonemic contrast and phonetic conditioning, particularly with respect to low and back vowel qualities.

More recent work has begun to address Qassimi Arabic specifically using instrumental methods. Al-Numair (2021) provides a descriptive and acoustic overview of the QA vowel system, arguing for a nine-vowel inventory and noting centralization and mid-vowel patterns that distinguish QA from other Saudi dialects. Parallel studies on QA segmental phonology (e.g., emphasis spread, affrication, syllable structure, and consonant clusters) further underscore the need for detailed, variety-specific analyses in this dialect (Abalkheel & Alhumameedi, 2025; Alnuqaydan, 2025; Albaty, 2025; Alharbi & Alammar, 2022). However, these studies do not resolve the phonemic vs. allophonic status of low back vowels, nor do they systematically test the relationship between vowel quality and length in QA.

Beyond Najdi and QA, acoustic research on other Arabic dialects demonstrates that vowel inventories and quality–quantity relations vary substantially across varieties. Jordanian and Palestinian Arabic have been shown to possess mid long vowels /eː, oː/ arising from monophthongization, with systematic spectral differences between long and short vowels (Alsharif & Khasawneh, 2025). Similar mid vowels and quantity–quality interactions are reported for Hijazi Arabic and other regional dialects, where long vowels are more peripheral and differ in both duration and formant structure from their short counterparts (Mahzari, 2023; Almurashi et al., 2024; Kalaldeh, 2018). Cross-dialect studies consistently find that dialects differ not only in the number of vowels but also in the spectral realization of seemingly "shared" categories (Alsharif & Khasawneh, 2025; Alqarhi, 2019; Mahzari, 2023; Kalaldeh, 2018; Alahmari, 2022). Within this broader context, Najdi and Qassimi vowel systems are expected to participate in similar patterns of expansion, centralization, and emergent contrasts.

Taken together, previous studies converge on the assumption that Najdi Arabic varieties possess three short and five long phonemic vowels, yet diverge substantially in their treatment of vowel realization and the phonological status of low and back vowel qualities. Crucially, much of the classic Najdi literature relies on impressionistic description, and the question of whether certain vowel qualities—particularly low back vowels—should be analyzed as phonemic or allophonic remains unresolved for Qassimi Arabic. Moreover, existing instrumental work on QA has not explicitly addressed the phonemic status of [ɑ] or the systematic relation between vowel quantity and quality (Al-Numair, 2021). This lack of consensus, set against growing cross-dialect acoustic evidence for richer and more variable Arabic vowel systems (Alsharif & Khasawneh, 2025; Alqarhi, 2019; Mahzari, 2023; Kalaldeh, 2018; , 2022), motivates the present study's combination of phonological diagnostics with instrumental phonetic evidence.

2.1 The Significance of the Present Study

Previous studies of Najdi Arabic vowels (Lehn, 1967; Johnstone, 1967; Prochazka, 1988; Ingham, 1994), together with more recent descriptive and theoretical work on Qassimi Arabic (Al-Numair, 2021; Al-Rashed, 2018; Alharbi & Alammar, 2022), have proposed differing analyses of both the phonemic inventory and the status of vowel variation, particularly with respect to short vowels and low vowel qualities (Abalkheel & Alhumameedi, 2025; Al-Numair, 2021; Alharbi & Alammar, 2022). While these studies offer valuable insights, classic accounts are largely impressionistic, and even acoustic descriptions typically stop short of testing whether specific vowel qualities (e.g. low back [ɑ]) function phonemically or remain allophonic. As shown in the preceding review, this lack of consensus is especially evident for varieties spoken in the Qassim region.

The significance of the present study lies in providing a variety-specific, empirically grounded analysis of the Qassimi Arabic vowel system that directly targets these open questions. By integrating phonological diagnostics (e.g. minimal pairs, morphological alternations) with acoustic measurements of vowel formants and duration, this study moves beyond earlier impressionistic accounts and complements existing QA descriptions by supplying explicit phonemic tests and quantitative evidence (Abalkheel & Alhumameedi, 2025; Al-Numair, 2021). In doing so, it contributes to a clearer understanding of how vowel systems may vary within Najdi Arabic, situates QA within cross-dialect patterns of vowel quality and quantity in Arabic (Alsharif & Khasawneh, 2025; Alqarhi, 2019; Mahzari, 2023; Kalaldeh, 2018; , 2022), and highlights the limitations of assuming a uniform phonological system across related dialects.

Specifically, the study addresses the following research questions:

1. What are the phonemic vowels in Qassimi Arabic?
2. What are the phonetic characteristics of these vowels, as reflected in their acoustic properties?

By answering these questions, the present study aims to clarify the status of Qassimi Arabic vowels—particularly low back vowels and the relation between short and long series—and to contribute to broader discussions of phonemic analysis, phoneme emergence, and dialectal variation in Arabic.

3. Methodology

To investigate the phonemic vowel system of Qassimi Arabic (QA), data were collected during a field trip to the Qassim region of Saudi Arabia. Recordings were conducted in Buraidah, the capital and most populous city in the region. Buraidah was selected as a representative site for QA due to its central location within Qassim and its role as a primary urban center in which the variety is widely spoken.

3.1 Participants

Three native speakers of Qassimi Arabic participated in the study. All participants were born and raised in the Qassim region, reported regular use of QA in daily communication, and indicated no speech or hearing impairments. To minimize potential influence from Modern Standard Arabic (MSA), participants were limited to those with no formal education beyond the high school level, as exposure to MSA increases substantially in higher education.

Dialectal authenticity was verified through a short spontaneous narrative produced by each speaker and evaluated by a native speaker of QA, following recommendations by Ladefoged (2003) for confirming dialect affiliation in communities where multiple varieties may be in use. Recordings were conducted individually and across multiple sessions to reduce potential accommodation or priming effects. Informed consent was obtained from all participants prior to recording, and all data were anonymized in accordance with ethical research standards.

Only male speakers were included. This restriction was adopted to obtain a preliminary acoustic characterization of QA vowels, as male and female speakers differ systematically in vowel formant frequencies due to physiological factors (Ladefoged, 2003). Limiting the sample therefore reduces inter-speaker acoustic variability unrelated to phonological structure.

3.2 Materials and Procedures

Speech data were recorded using a digital recorder and an external headset microphone to ensure consistent audio quality. Recordings were made at a sampling rate of 22,000 Hz, following recommendations for acoustic analysis of speech (Ladefoged, 2003). All sessions were conducted in quiet indoor settings to minimize background noise and acoustic interference. Each speaker was recorded individually to avoid accommodation or priming effects.

To elicit vowel tokens, a list of 157 phrases containing monosyllabic target words was constructed. The list included 67 words targeting long vowels, 70 words targeting short vowels, and 20 filler items. Target vowels were placed between obstruents whenever possible to facilitate segmentation and reduce ambiguity at vowel boundaries. The distribution of tokens across vowel categories is summarized in Table 1.

Table 1. Distribution of target words across vowel categories

Category	Vowel	Number of words	Category	Vowel	Number of words
Long	aː	30	Short	a	33
	uː	11		i	28
	iː	9		u	9
	oː	9			
	eː	8			

All target words were presented in Arabic orthography. This choice reduced potential priming effects, as short vowels are not represented in Arabic writing and long vowels are only partially encoded orthographically (Ingham, 1988). Target words were produced within short carrier phrases rather than in isolation, following Ladefoged's (2003) observation that vowel duration and quality are more reliably measured in connected speech. Carrier phrases were selected based on natural frequency and collocational plausibility, providing contextual cues to the intended lexical items.

Each target word was produced twice consecutively by each speaker to ensure consistency. The resulting tokens were later averaged for acoustic analysis.

3.3 Analysis

The collected data were analyzed using a combination of phonological and phonetic approaches. Phonological analysis followed the general principles outlined in Burquest (2006), focusing on the identification of contrast, complementary distribution, and patterns of variation in order to establish the phonemic vowel inventory of Qassimi Arabic. All recorded tokens were phonetically transcribed and grouped according to vowel quality, allowing for systematic comparison across lexical items and phonological environments.

Acoustic analysis was conducted using Praat. Following standard procedures for vowel analysis (Ladefoged, 2003), vowel formants were measured at a steady-state point near the temporal midpoint of each vowel to minimize the effects of consonantal perturbation. The first two formants (F1 and F2) were taken as the primary acoustic correlates of vowel quality, and vowel duration was also measured for each token.

Each target word was produced twice by each speaker. For each speaker, measurements from the two repetitions were averaged, and speaker means were subsequently averaged across the three participants. This approach was adopted to characterize the overall vowel space of Qassimi Arabic rather than to model inter-speaker variation. Mean F1 and F2 values for each vowel category were then plotted on an F2–F1 plane using JPlot to visualize the relative distribution of vowels in the acoustic space. These acoustic results were interpreted alongside phonological evidence in determining phonemic contrasts.

4. Results/Findings

4.1 Overview of the Qassimi Arabic Vowel System

Analysis of 157 elicited tokens produced by three native speakers indicates that Qassimi Arabic (QA) has **four short vowels** and **five long vowels**. The short vowel inventory consists of /i, a, ɑ, u/, while the long vowel inventory consists of /iː, eː, aː, uː, oː/. The proposed system is summarized in Figure 1.

	Front	Central	Back
High	i, iː		u, uː
Mid	eː		oː
Low		a, aː	ɑ

Figure 1. Qassimi Arabic phonemic vowel system.

A central finding is the contrast between the low front vowel /a/ and the low back vowel /ɑ/. Unlike earlier accounts that treat [ɑ] as an allophone conditioned by emphatic or uvular consonants, the present data provide phonological and acoustic evidence that /ɑ/ functions as an independent phoneme in QA, albeit with some variability across environments. In addition, the acoustic results show that long vowels occupy a relatively wide and well-defined vowel space, while short vowels are more tightly clustered. The following sections elaborate these findings, beginning with the short vowel system.

4.2 Short Vowels

4.2.1 Phonological Evidence

The short vowel system in QA exhibits contrasts in both height and backness. In addition to the front–back distinction among high vowels (/i/ vs. /u/), QA shows a backness distinction among low vowels (/a/ vs. /ɑ/), which is central to the present analysis.

Clear contrast between the high front vowel /i/ and the low front vowel /a/ is evidenced by minimal pairs such as:

- /bass/ → [bass] 'enough'
- /biss/ → [biss] 'cat'

Additional support for this contrast comes from productive morphological alternations in which vowel quality distinguishes verbal categories, for example between perfective and imperative forms. These patterns indicate that the /i/–/a/ contrast is systematic and not restricted to isolated lexical items.

A parallel contrast is observed between the high back vowel /u/ and the low back vowel /ɑ/, as in:

- /gubb/ → [gubb] 'kick (IMP)'
- /gɑbb/ → [gɑbb] 'kick (PFV)'

This alternation follows a recurring morphological pattern in which imperative forms with /u/ correspond to perfective forms with /ɑ/, reinforcing the phonemic status of both vowels.

Crucially, QA also shows contrast between the two low vowels /a/ and /ɑ/ in identical phonological environments:

- /daff/ → [daff] 'warm up (IMP)'
- /dɑff/ → [dɑff] 'push (PFV)'

These contrasts demonstrate that /ɑ/ cannot be analyzed solely as an allophone of /a/ conditioned by emphatic consonants. The low back vowel occurs with non-emphatic consonants as well, including velar stops and fricatives. At the same time, limited variation is attested in some lexical items (e.g. [ʃabb] ~ [ʃɑbb]), suggesting that /ɑ/ may be an emerging or partially stabilized phoneme in QA rather than a purely marginal one.

Taken together, the phonological evidence supports a four-vowel short system in QA, with independent phonemic contrasts in both height and backness.

4.2.2 Acoustic Evidence

The phonological distinctions among short vowels are supported by acoustic measurements of vowel quality and duration. Table 2 summarizes mean F1, F2, and duration values for each short vowel, averaged across speakers and repetitions. The high vowels /i/ and /u/ differ substantially in frontness, with mean F2 values differing by more than 550 Hz, while exhibiting similar durations. The low vowels /a/ and /ɑ/ show comparable height and duration, but differ consistently in backness, with mean F2 values separated by over 200 Hz. These patterns indicate that the low vowels occupy distinct regions of the vowel space despite their proximity. The short vowels form a relatively compact vowel space with some overlap among categories (Figure 2).

Table 2: QA Short Vowels: Acoustic Properties

Vowel	F1 range (Hz)	Mean F1 (Hz)	F2 range (Hz)	Mean F2 (Hz)	Duration range (ms)	Mean duration (ms)
/i/	368–431	393	1603–2054	1850	49–82	63
/u/	414–476	442	881–1515	1281	44–97	66
/a/	502–535	540	1511–1753	1619	63–99	81
/ɑ/	533–617	585	1390–1476	1435	65–80	74

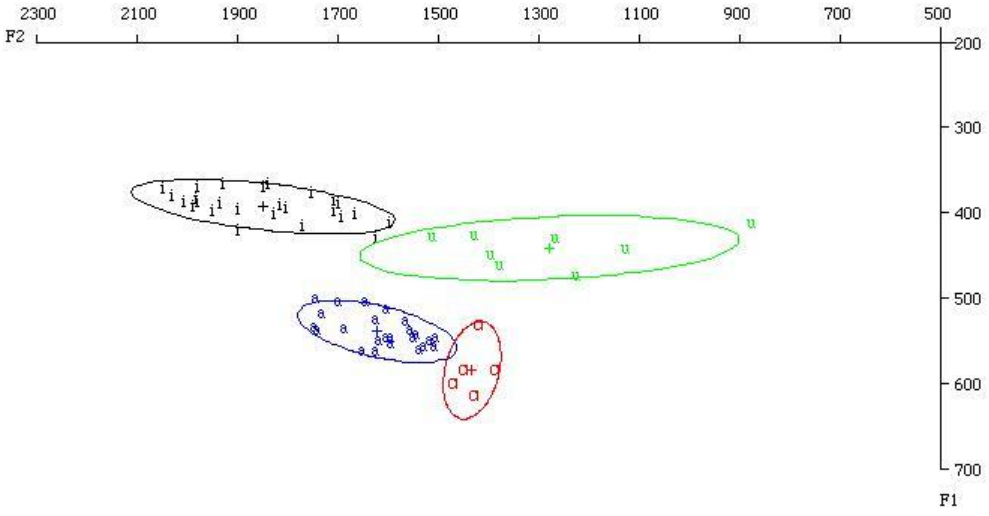

Figure 2. F1–F2 plot of short vowels in Qassimi Arabic

4.3 Long Vowels

4.3.1 Phonological Evidence

The long vowel system of QA consists of /iː, eː, aː, uː, oː/. These vowels occur in contrastive environments and show clear phonemic distinctions based on height and backness.

Phonemic contrast among the high and mid long vowels is illustrated by minimal pairs such as:

- /diːk/ → [diːk] 'rooster'
- /duːk/ → [duːk] 'take'

and:

- /beːt/ → [beːt] 'house'
- /boːt/ → [boːt] 'boot'

The low long vowel /aː/ also contrasts with both high and mid long vowels, as in:

- /daːk/ → [daːk] 'make even (PFV)' vs. /diːk/ → [diːk] 'rooster'
- /baːt/ → [baːt] 'sleep (PFV)' vs. /beːt/ → [beːt] 'house'
- /faːt/ → [faːt] 'go (PFV)' vs. /foːt/ → [foːt] 'bygones'

Such pairs show that differences in vowel quality alone are sufficient to distinguish lexical meaning, even when consonantal environments are identical. Together, they establish that QA long vowels form a fully contrastive five-vowel system.

4.3.2 Acoustic Evidence

Table 3 presents mean F1, F2, and duration values for each long vowel, averaged across speakers and repetitions. The acoustic data show that long vowels occupy a well-defined and expanded vowel space. High vowels /iː/ and /uː/ exhibit similar heights (F1), but differ markedly in frontness, with mean F2 values separated by more than 1000 Hz. The mid vowels /eː/ and /oː/ likewise show close similarity in height and duration while maintaining a front–back F2 difference of over 700 Hz. The low vowel /aː/ differs from the mid vowels by approximately 100 Hz in F1 and occupies a more central position in the vowel space, as reflected in its mean F2 value. Long vowels also show consistently greater duration than short vowels, with mean durations around 110–140 ms.

Table 3: Long Vowels: Acoustic Properties

Vowel	F1 range (Hz)	Mean F1 (Hz)	F2 range (Hz)	Mean F2 (Hz)	Duration range (ms)	Mean duration (ms)
/iː/	326–361	346	2090–2174	2120	94–133	110
/uː/	374–409	390	856–1270	1072	92–160	121
/eː/	425–482	451	1779–1992	1868	101–130	117
/oː/	480–502	489	1033–1227	1118	105–188	140
/aː/	551–616	581	1435–1722	1564	112–177	134

The overall distribution of long vowels forms the expected V-shaped configuration characteristic of a five-vowel system, with clear separation and minimal overlap (see Figure 3), in contrast to the more compact and partially overlapping vowel space observed for short vowels (see Figure 2).

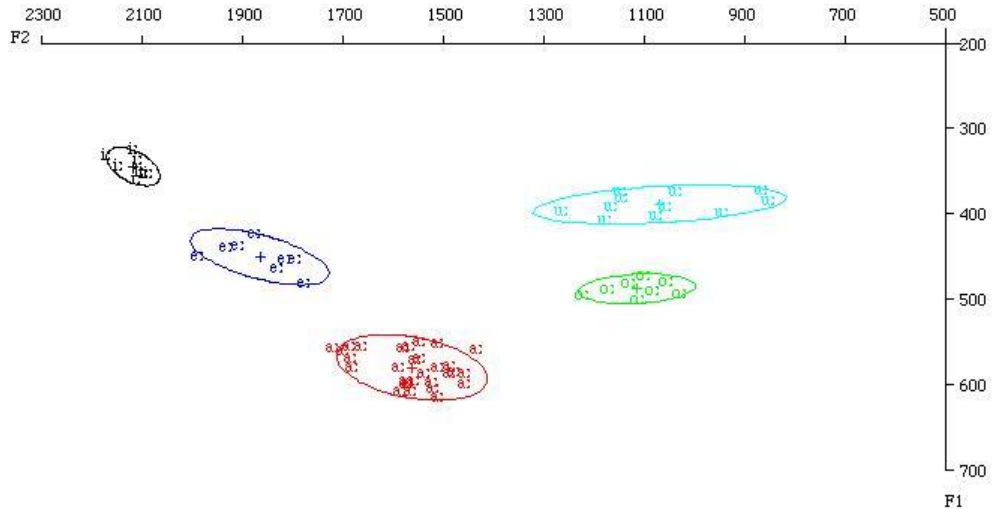

Figure 3. F1–F2 plot of long vowels in Qassimi Arabic.

4.4 Short vs. Long Vowels

A direct comparison of short and long vowels in Qassimi Arabic reveals systematic differences in both duration and acoustic separation. While short and long vowels share comparable height distinctions, long vowels exhibit clearer front–back separation and substantially greater duration.

Table 4 summarizes the mean F1, F2, and duration values for the three vowel qualities that have both short and long counterparts (/i, u, a/).

Table 4: Short vs. Long Vowels

Vowel	Short			Long		
	Mean F1 (Hz)	Mean F2 (Hz)	Mean D (ms)	Mean F1 (Hz)	Mean F2 (Hz)	Mean D (ms)
i	393	1850	63	346	2120	110
u	442	1281	66	390	1072	121
a	540	1619	81	581	1564	134

The data show that short and long vowels of the same quality have similar F1 values, with differences generally below 60 Hz, indicating comparable vowel height. In contrast, high vowels differ more noticeably in frontness: long /iː/ and /uː/ show greater separation in F2 than their short counterparts. Duration provides the clearest distinction, with long vowels being nearly twice as long as short vowels across all vowel qualities.

These differences are visualized in Figure 4, which plots short and long vowels in the same acoustic space. The figure highlights the tighter clustering and partial overlap among short vowels, in contrast to the more dispersed and clearly separated long vowels. Taken together, these results indicate that vowel length in QA is not realized solely as temporal expansion. Rather, long vowels also exhibit enhanced spectral distinctiveness, with both duration and vowel quality contributing to phonemic contrast.

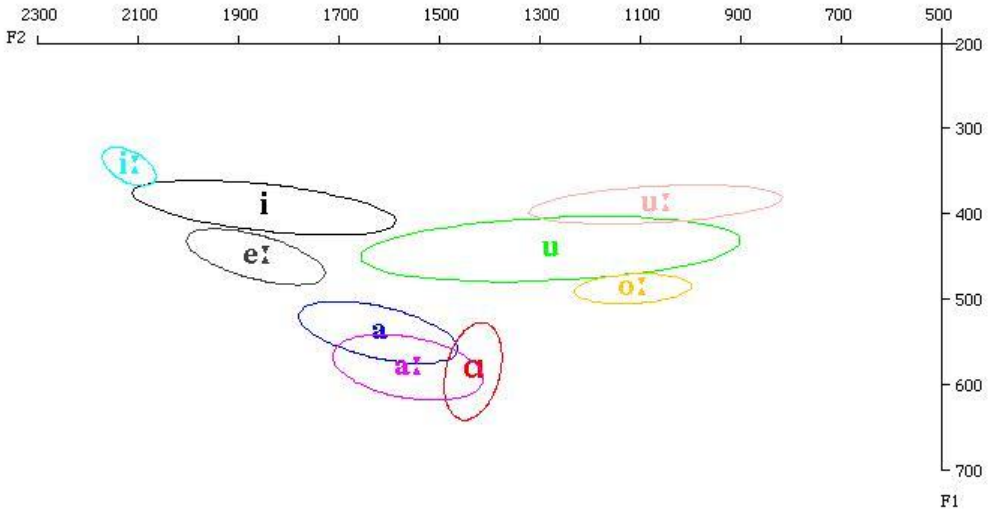

Figure 4. F1–F2 plot comparing short and long vowels in Qassimi Arabic.

4.5 Interim Summary

The combined phonological and acoustic evidence supports a revised analysis of the Qassimi Arabic vowel system. The data compel the recognition of four short vowels (/i, a, ɑ, u/) and five long vowels (/iː, eː, aː, uː, oː/). In particular, the low back vowel /ɑ/ emerges as a phoneme distinct from /a/, supported by minimal contrasts, productive morphological alternations, and consistent acoustic separation.

While short vowels occupy a compact and partially overlapping vowel space, long vowels display clear categorical separation in both quality and duration, forming a stable five-vowel system consistent with typological expectations. The contrast between short and long vowels thus involves both temporal and spectral cues, with vowel length and vowel quality jointly contributing to phonemic distinction.

These findings demonstrate that Qassimi Arabic cannot be fully captured by vowel inventories proposed for Najdi Arabic as a whole. Instead, the QA vowel system exhibits variety-specific properties that underscore the importance of empirical, dialect-focused analysis. The following conclusion situates these results within broader discussions of Arabic vowel systems and phonemic representation.

5. Conclusion

This study examines the phonemic vowel system of Qassimi Arabic using phonological diagnostics and acoustic analysis, providing the first integrated argument for a phonemic low back vowel in QA. Based on 157 elicited tokens from three native speakers, the results support a vowel inventory of four short vowels (/i, a, ɑ, u/) and five long vowels (/iː, eː, aː, uː, oː/). In contrast to earlier descriptions of Najdi Arabic, which typically treat the low back vowel [ɑ] as an allophone conditioned by emphatic or uvular consonants (Lehn, 1967; Johnstone, 1967; Ingham, 1994; Prochazka, 1988), the present findings provide converging phonological and acoustic evidence that /ɑ/ functions as a phoneme in QA. This aligns with more recent work that also recognizes a contrastive low back vowel in QA and related Najdi varieties (Abalkheel & Alhumameedi, 2025; Alharbi & Alammar, 2022).

The recognition of /ɑ/ as a phonemic short vowel is a central empirical contribution. Minimal contrasts, productive morphological alternations, and consistent acoustic separation from /a/ collectively argue against a purely allophonic account and support proposals that QA has a richer vowel system than the canonical three-short–three-long description (Al-Numair, 2021; Abalkheel & Alhumameedi, 2025; Alharbi & Alammar, 2022; Alhoody & Aljutaily, 2020). At the same time, residual variation in certain lexical items suggests that /ɑ/ may be an emerging or partially stabilized phoneme, paralleling cases where segmental contrasts in Arabic dialects display quasi-phonemic or change-in-progress behavior (Freeman, 2019; Abed, 2022). This

underscores the importance of examining individual varieties rather than assuming uniform vowel systems under broad labels such as "Najdi Arabic" (Alhoody & Aljutaily, 2020).

The acoustic analysis further reveals systematic differences between short and long vowels: short vowels occupy a relatively compact and partially overlapping space, whereas long vowels show clearer spectral separation and substantially greater duration. This pattern converges with instrumental studies of other Arabic dialects, where long vowels are more peripheral and differ from short vowels in both quantity and quality (Al-Mazrouei et al., 2023; Almurashi, 2025; Almurashi et al., 2024; Alsharif & Khasawneh, 2025). The QA data thus reinforce the view that vowel length in Arabic is cued by both temporal and spectral properties, and that quantity–quality interactions are integral to the phonological organization of Arabic vowel systems (Al-Numair, 2021; Almurashi et al., 2024; Alsharif & Khasawneh, 2025).

More broadly, the findings contribute to variety-specific, instrumentally grounded descriptions of QA, complementing recent work on its vowel inventory, emphasis spread, syllable structure, and other segmental and prosodic phenomena (Al-Numair, 2021; Abalkheel & Alhumameedi, 2025; Alharbi & Alammar, 2022; Alhoody & Aljutaily, 2020). By showing that the QA vowel system cannot be straightforwardly reduced to inventories proposed for Najdi Arabic as a whole (Alhoody & Aljutaily, 2020), this study adds to cross-dialect evidence that Arabic vowel systems exhibit substantial internal variation in both size and structure (Al-Numair, 2021; Al-Mazrouei et al., 2023; Almurashi et al., 2024; Alsharif & Khasawneh, 2025; Brown & Hellmuth, 2022; Abed, 2022). It thereby offers new data for discussions of phoneme emergence, allophony, and the dynamics of phonological change in Semitic languages (Alharbi & Alammar, 2022; Freeman, 2019; Abed, 2022).

Future research should expand the speaker sample and phonological environments, including additional syllable types, prosodic contexts, and sociophonetic factors, and conduct comparative analyses with neighboring Najdi and non-Najdi dialects. Such work would clarify the stability and distribution of /ɑ/, test whether similar low-vowel splits arise elsewhere, and further situate QA within broader typological patterns of Arabic vowel variation (Al-Numair, 2021; Al-Mazrouei et al., 2023; Almurashi et al., 2024; Alsharif & Khasawneh, 2025; Abed, 2022).

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