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An Acoustic Analysis of Description and Classification of Balti Segmental (Velar Sounds) Consonants

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Abstract

The goal of this study is to categorize solely the consonants (velars) of the Balti language, which is spoken in Pakistan's Baltistan area of Gilgit Baltistan. The Balti language was chosen for the study because it is one of the less well-known languages in Pakistan and because there has never been any substantial research done on the language's sounds or sound system.120 distinct words from various Balti novels were chosen in order to categorize Balti sounds. Using the program PRAAT, the acoustic analysis of Balti consonants has been examined to demonstrate their physical characteristics. In order to capture samples of various Balti consonant sounds, the investigators identified 20 indigenous Balti speakers, aged 16 to 35, enrolled in State College for Boys in Model Town and University of Technology and Management, Lahore, Pakistan. Spectrophotograms representing each sound were used to display the physical characteristics of the native Balti speakers' sound samples. The Balti

language has ten fricative sounds, according to acoustic examinations of consonant sounds.

Keywords: Fricatives, Consonants, spectrogram, description, classification, Acoustic analysis, phonemic, allophonic

1. Introduction

Nowhere in the world are so many high peaks concentrated in such a small area as in Baltistan. in the region speak Baltic. the Himalayan Sino-Bodic group, which arose from the Sino-Tibetan family of Tibeto-Burman languages, the second most spoken family in the world[1]. English and other European languages belong to this language family. Balti is like one of the oldest civilizations of the Baot, or bonpo (followers of Bon) ethnic group, and the religion of bonshamanism[2]. an influential and strong-minded individual, was then the great rulr of the Tibetan Mesa, and the great Tibetan was known as Ol-mo Lunring. However, the breakup of the Great Tibetan Empire brought that disastrous process of learning and teaching systems to a terrible end[3]. The Thai version is extinct, while Ochan exists and is used to write in and around Ladakh, but after the arrival of Islam in the region in the 14th century AD. religious relations of Baltistan were severed from other parts of Greater Tibet. of Persian and Arabic languages[4].

2. Literature Review

If you look at the number of people who speak the Baltic language and look at the size of their geographical area, you will not notice that grammar and phonology have not been tried and described. A little has been said about phonology. Early work in this regard can be seen in the works of Austen[5]. In 1866, Austen a famous researcher of the Karakoram, published the first European who published a Baltic dictionary[6]. With Austen's works in mind, he included a slightly more detailed, albeit small, vocabulary and notes on both Baltic and Purkinese grammars in Volume III of his Survey of Indian Languages. Bailey added Purk's more detailed grammar and dictionary in 1915[7]. In addition to all these contributors, Ed published in 1934 the most comprehensive Baltic grammar and dictionary to date consisting of more than 2,000 words. Some 40 years later, Rangan added Purkin's Phonology and

Grammar (Baltic dialect) in 1979. In terms of phonetic notation, Rangan's contribution is the most accurate work because his predecessors were largely ignorant of the nature of certain sounds[8]. found in Balticus and Purki, especially in the palatal nasal [n], which they recorded differently as [n], [K], [ny] or [Ky][9]

H.A Jaschke says that many Balti words were originally derived from Hindi; he hypothesized that many Balti sounds are similar to Hindi sounds. In the same book, he mentioned 30 Balti consonant letters and 4 diacritical symbols for Baltic vowel sounds[10]. Jaschke did not prove these sounds scientifically instead; he thought of letters as sounds.

3. Methodology

The details of the methodology are given under the relevant sub-headings.

3.1. Participants

To conduct this study, 20 native Balti speakers of between the ages of 16 and 35 were selected who were students at Govt College (Boys) Model City and University of Management and Technology in Lahore, Pakistan.

3.2. Procedure

For the classification of consonants of Balti, 120 different words were selected from different Baltic books. The acoustic analysis of Baltic consonants was checked to show their physical properties using PRAAT software.

4. Discussion

To describe the place of articulation of each sound, a diagram of every individual sound is made. On the other hand, spectrogram of each sound has also been made which indicates the manner of articulation, i.e., fricatives, voiced, voiceless, aspirated and un-aspirated features of each sound. The voiced sound is also shown in the diagram with the help of this mark ( ). Minimal pairs were made to check the existence of different sounds. The observation of researcher has been discussed and the data was analyzed with the help of the diagram and spectrogram mentioned with each sound. Finally, the findings of this study have been mentioned at the end of data analysis.

Analysis

4.1 Minimal pairs for ځ غ /ɣ and x/ sounds

The existence of phonemes /**ɣ** / and / **x** / in Balti language has been checked through the following minimal pairs.

Minimal pairs	Transcription	Meaning
kho	/xəʊ/	bitter
gho	/ɣəʊ/	Cray
kha	/xə/	anger
gha	/ɣə/	five
khash	/xəʃ/	love
ghash	/ɣəʃ/	complete

Finding

The above pairs show that the phoneme / **x**/ and /ɣ / exist in Balti language.

Observation on phoneme /x/ of the Balti language by the researcher is shown in

Diagram 4.1 and Table 4.1

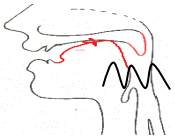


Diagram 4.1

Table 1Table 4.19: Description of phoneme /x/ in Balti language

IPA symbol	/x/
Place of articulation	Velar
Manner of articulation	Fricative
Voicing	Voiced
As-un-aspirated	un-aspirated
Perso-Arabic letter	ځ

4.1. ځ /x/ (Voiced Velar fricatives)

Analysis

The phoneme /x/ is a voiced velar fricative in Balti language. During the production of this sound the back of the tongue comes to the soft palate as shown in the diagram 4.1, which narrows the air passage due to which the air pressure is increased through diaphragm and when it is released, the sound

comes through the narrow passage along with a friction noise as it touches the velar arch. During the production of this sound vibration has been observed in the vocal cords during acoustic analysis of this sound through Praat shown in the spectrogram 4.1. Therefore, it is a voiced sound.

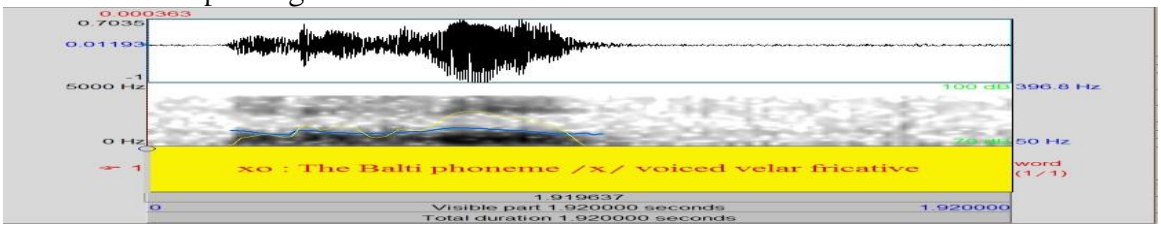


Figure 1The spectrogram 4.1: The Balti phoneme /x/

Observation on phoneme /ɣ/ of the Balti language by the researcher is shown in:

Diagram 4.2 and Table 4.2

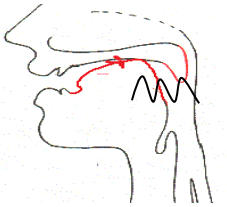


Diagram 4.2

Table 2 Table 4.2: Description of phoneme /ɣ/ in Balti language

IPA symbol	/ɣ/
Place of articulation	Velar
Manner of articulation	Fricative
Voicing	Voiced
As-un-aspirated	un-aspirated
Perso-Arabic letter	غ

1. 2 غ /ɣ/ (Voiced Velar fricatives)
2. **Analysis**

The phoneme /ɣ/ is a voiced velar fricative in Balti language. During the production of this sound, the back of the tongue touches the back of soft palate as shown in the diagram 4.2. Meanwhile, the air pressure increases through diaphragm. When the air is released, the sound comes through the

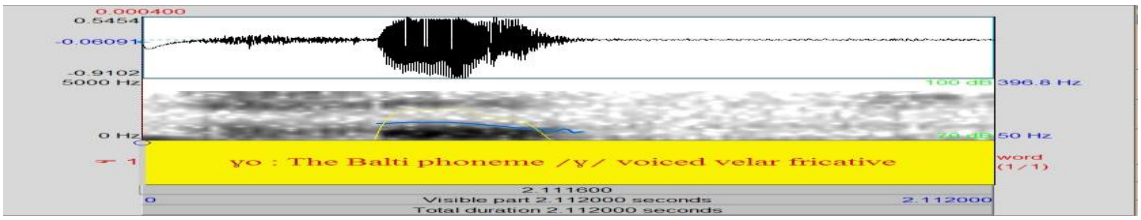


Figure 2The spectrogram 4.2: The Balti phoneme / ɣ /

narrow passage with a friction noise. While producing this sound, vibration has been observed during acoustic analysis with the help of Praat computer software shown in the spectrogram 4.2. Therefore, it is a voiced sound. However, this sound is not found in other Tibetan languages (Old Tibet, Proto Western Tibet, and Modern Tibet) because this is again not an original Tibetan sound, (see in second section of chapter 2). It has been used for accommodating the Balti sound which remained un-accommodated.

The phonemes /k/, /g/ and /k^h/ have been checked through the following minimal pairs.

Minimal pairs	Transcription	Meaning
koq	/kəʊq/	snatch
goq	/gəʊq	apart
k^hoqs	/ k^hoqs/	cuff
kus	/kəs/	listened
gus	/gəs/	Canvass
k^hos	/k^hos/	He
kul	/ku:l	put
gul	/gu:l/	lazy/ tired
k^hul	/k^hul/	ill

Finding

The above minimal pairs show that the phonemes /k/, /g/ and /k^h/ exist in Balti language. The minimal pairs show that aspiration does not mark an allophonic contrast as it does in English; instead, aspiration marks phonemic contrast in Balti.

Observation on phoneme /k/ of the Balti language by the researcher is shown in:

Diagram 4.3 and Table 4.3

Diagram 4.3 of phoneme /k/ in Balti language

Table 3Table 4.3: Description

IPA symbol	/k/
Place of articulation	Velar
Manner of articulation	Stop
Voicing	Voiceless
As-un-aspirated	un-aspirated
Perso-Arabic letter	ك

4.3 ك /k/ (Voiceless Velar stop)

Analysis

The phoneme /k/ is a voiceless velar ending in Baltic. It can be produced with and without aspiration, as in English un-aspirated /k/ and aspirated /kh/. English has an allophonic contrast, while Baltic has a phonemic contrast. In the articulation of this phoneme, the back of the tongue produces this sound with the soft palate, as shown in Diagram 4.7. When the back of the tongue touches the soft palate, the air momentarily stops, after which the airflow is suddenly released without aspiration (see spectrogram 4.3). In addition, during the acoustic analysis of this sound using Praat computer software, no vibration was detected in the production of this sound, which is shown in spectrogram 4.3. Therefore, it is the voice of the voiceless. This sound can occur at the beginning, middle and end of a Baltic word.

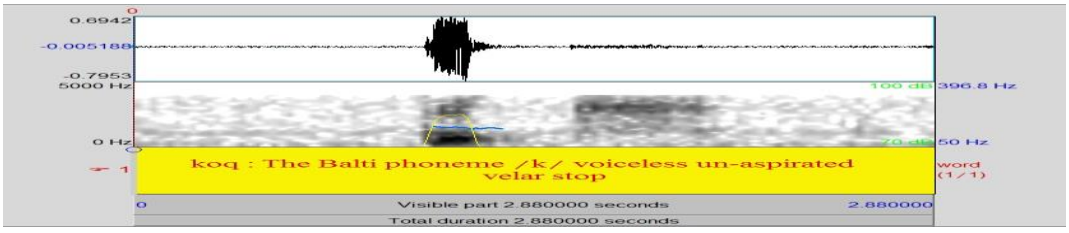


Figure 3The spectrogram 4.7: The Balti phoneme /k /

Observation on phoneme /g/ of the Balti language by the researcher is shown in

Diagram 4.4 and Table 4.4

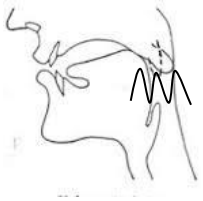


Diagram 4.4

Table 4Table 4.8: Description of phoneme /g/ in Balti language

IPA symbol	/g/
Place of articulation	Velar
Manner of articulation	Stop
Voicing	Voiced
As-un-aspirated	un-aspirated
Perso-Arabic letter	گ

4.4 گ /g/ (Voiced Velar stop)

Analysis

The phoneme /g/ is a voiced velar stop sound in Balti language. In the articulation of this phoneme, the back of the tongue touches the soft palate shown in the diagram 4.8. When the back of the tongue touches the soft palate the air completely stops first followed by sudden release of the airstream without any aspiration as shown in the spectrogram 4.4. A strong vibration has been observed during acoustic analysis of this sound through Praat shown in the spectrogram 4.4. Therefore, this is a voiced sound.

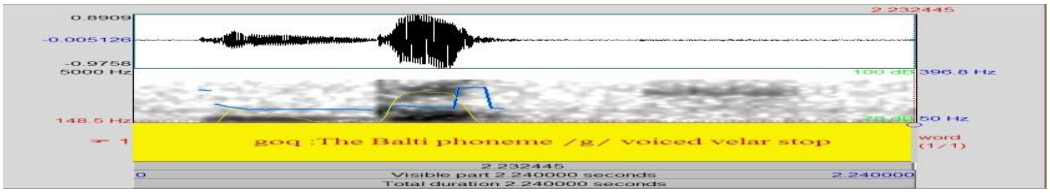


Figure 4The spectrogram 4.4: The Balti phoneme /g /

Observation on phoneme /k^h / of the Balti language by the researcher is shown in

Diagram 4.5 and Table 4.5

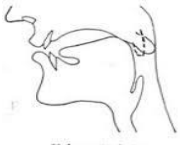
The place of articulation of  **Diagram 4.5** the phoneme **/k^h/** in Balti language

Table 5 Table 4.4: Description of phoneme /kh / in Balti language

IPA symbol	/k^h /
Place of articulation	Velar
Manner of articulation	Stop
Voicing	Voiceless
As-un-aspirated	Aspirated
Perso-Arabic letter	کھ

4.5. /k^h / (Voiceless Velar stop)

Analysis

The phoneme /g/ is a voiced veal stop in Baltic. In the articulation of this phoneme, the back of the tongue touches the soft palate shown in diagram 4.8. When the back of the tongue touches the soft palate, the air first stops completely, after which the air flow is suddenly released without aspiration, as in spectrogram 4.4. In the acoustic analysis of this sound through Praat, a strong vibration was observed, which can be seen in spectrogram 4.4. Therefore, it is a voiced sound.

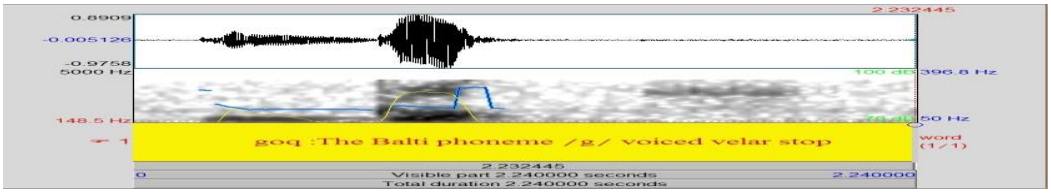


Figure 5The spectrogram 4.5: The Balti phoneme/kh /

4.6 Minimal pairs for /kʳ / and /gʳ /sound

The phoneme /**kʳ**/ and /**gʳ**/ have been checked through the following minimal pairs.

Minimal pairs	Transcription	Meaning
Kʰraq	/ **kʳ**əq/	blood
gʰʳəqs	/**gʳ**əqs/	agreed
kʳol	/ **kʳ**ol/	open
gʳol	/**gʳ**ol/	opened
kʰʳos	/ **kʳ**os/	anger
gʰʳong	/**gʳ**ong/	village

Finding

The above minimal pairs show that the phonemes /**kʳ**/ and /**gʳ**/ exist in Balti language.**Observation** on phoneme /**kʳ**/ of the Balti language by the researcher is shown in Diagram 4.6 and Table 4.6

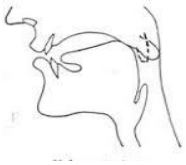


Diagram 4.6

Table 6Table 4.6: Description of phoneme / kr / in Balti language

IPA symbol	/ **kʳ** /
Place of articulation	Velar
Manner of articulation	Stop
Voicing	Voiceless

As-un-aspirated	Aspirated
Perso-Arabic letter	

4.6.I / k^r / (Voiceless Velar stop)

Analysis

The phoneme / kr / is a velar ending in the Baltic language. In the articulation of this phoneme, the back of the tongue touches the soft palate, as in figure 4.6. When the back of the tongue touches the soft palate, the air stops, after which the airflow suddenly starts up with a strong aspiration (see spectrogram 4.6). In the acoustic analysis of the computer software Praat, no oscillation was detected in the production of that sound, which can be seen in spectrogram 4.6. Therefore, this phoneme is voiceless.

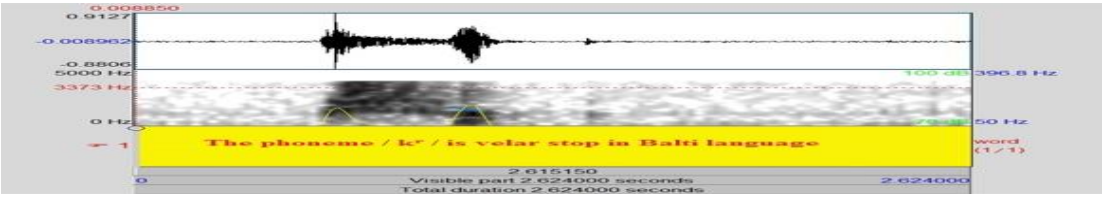


Figure 6The spectrogram 4.6: The Balti phoneme / kr /

Observation on phoneme /g^r / of the Balti language by the researcher is shown in

Diagram 4.7 and Table 4.7

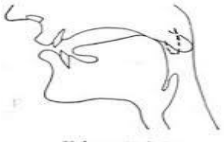


Diagram 4.7

Table 7Table 4.7: Description of phoneme / gr / in Balti language

IPA symbol	/ g^r /
Place of articulation	Velar
Manner of articulation	Stop
Voicing	Voiced
As-un-aspirated	Un-aspirated

Perso-Arabic letter	

4.7. / gʳ/ (Voiced Velar stop)

Analysis

The phoneme /gr/ is a voiced aspirated velar ending in Baltic. In the articulation of this phoneme, the back of the tongue touches the soft palate as in Figure 4.7. When the back of the tongue touches the soft palate, the air first stops and then the airflow is suddenly released without aspiration. The acoustic analysis of the computer software Praat detected a strong oscillation in the production of this sound, which can be seen in spectrogram 4.7. So it's a voiced sound.

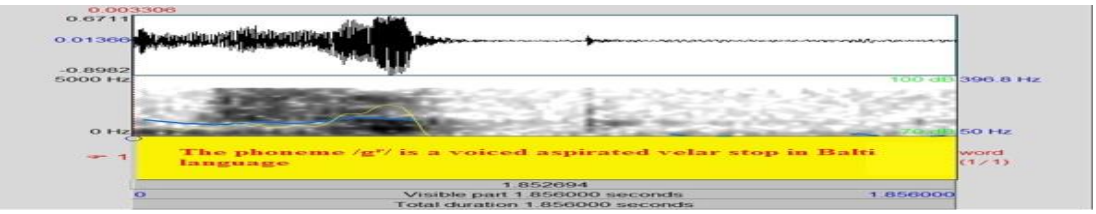


Figure 7The spectrogram 4.7: The Balti phoneme/ gr /

4.8 Minimal pairs for /n/, /ɴ/ and /ɲ/, /ŋ/ sounds

The existence of phonemes /ɴ/, /ɲ/ and /ŋ / in Balti language has been checked through the following minimal pairs.

Minimal pairs	Transcription	Meaning
neya	/ɲə/	fish
nayr	/ɲər/	piece of cloth
shing	/ʃɪŋ/	wood
Sing	/sɪŋ/	All
nga	/ ɴa/	me
ngas	/ ɴs/	Me

Finding

The above pairs show that the phonemes /n, ɴ, ɲ and ŋ / exist in Balti language.

Observation on phoneme / ŋ / of the Balti language by the researcher is shown in:

Diagram 4.8 and Table 4.8

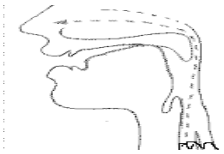


Diagram 4.8

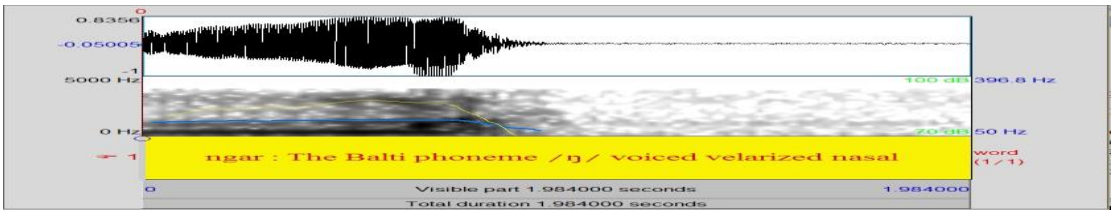
Table 8Table 4.8: Description of phoneme / ŋ / in Balti language

IPA symbol	/ ŋ/
Place of articulation	Velar
Manner of articulation	Nasal
Voicing	Voiced
As-un-aspirated	un-aspirated
Perso-Arabic letter	

4.8 / ŋ/ (Voiced velarized Nasal)

Analysis

The phoneme / ŋ / is a voiced velarized nasal sound in Baltic. To produce this sound, the Baltic speaker raises the back of the tongue to the soft palate, as shown in Figure 4.8. When the back of the tongue touches the soft palate, the air stops and is released through the nasal cavity. During the generation of this sound, the researcher observed a strong vibration during the acoustic analysis of this sound using Praat computer software as shown in spectrogram



4.8. Therefore, it is a resonant sound

Figure 8The spectrogram 4.8: The Balti phoneme / ŋ /

Observation on phoneme /ɲ/ of the Balti language by the researcher is shown in

Diagram 4.9 and Table 4.9

Diagram 4.9

Table 9Table 4.9: Description of phoneme /ɲ/ in Balti language

IPA symbol	/ɲ/
Place of articulation	Palatal
Manner of articulation	Nasal
Voicing	Voiced
As-un-aspirated	un-aspirated
Perso-Arabic letter	ɲ

4.9 /ɲ/ (Voiced velarize nasal)

Analysis

The phoneme /ɲ/ is a voiced velar nasal sound in Balti language. In the production of this sound the back of tongue touches the soft palate and the air is stopped in the oral cavity, followed by sudden release of airstream. The air passes through nasal cavity as shown in the diagram 4.9. A strong vibration has been observed during acoustic analysis of this sound through Praat shown in the spectrogram 4.9. Therefore, this is a voiced sound.

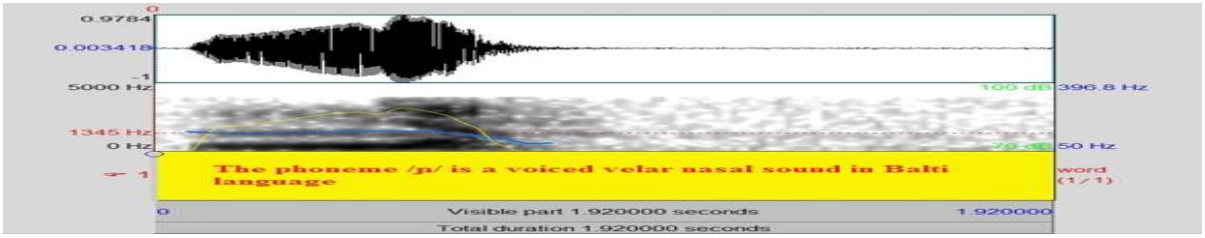


Figure 9The spectrogram 4.9: The Balti phoneme /ɲ/

Observation on phoneme /ŋ/ of the Balti language by the researcher is shown in

Diagram 4.10 and Table 4.10

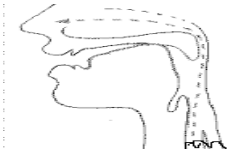


Diagram 4.10

Table 10Table 4.10: Description of phoneme /ŋ/ in Balti language

IPA symbol	/ŋ/
Place of articulation	Velar
Manner of articulation	Nasal
Voicing	Voiced
As-un-aspirated	un-aspirated
Perso-Arabic letter	

4.10 /ŋ/ (Voiced Velar nasal)

Analysis

The phoneme /ŋ/ is a voiced Velar nasal sound in Balti language. To produce this sound, the returned of the tongue touches the gentle palate as proven with inside the diagram 4.27. The air is blocked with inside the oral hollow space via way of means of the returned of the tongue pressed the gentle palate and the air passes via the nasal hollow space. A robust vibration has been determined for the duration of acoustic evaluation of this sound via Praat as

Figure 10The spectrogram 4.10: The Balti phoneme /ŋ/

proven with inside the spectrogram 4.27. Therefore, that is a voiced sound.

5.1 Findings

10 Velar phonemes, i.e., /k/, /g/,/kʰ/, /kʳ/, /gʳ/, /x/, /ɣ/ and /ɲ/, /ɴ/ /ŋ / have been found in Balti language. These phonemes are produced by the Balti native speakers by touching the back of tongue with the soft palate. Therefore, they are known as velar sounds.

5.2. Limitation of the study

The study limits only the description and classification of Baltic fricative (consonant) sounds and recommends the future researcher to study other consonant and vowel sounds, phonological reconstruction and syllabic structure of Baltic.

Conclusion

The Balti language was chosen for the study because it is one of the less well-known languages in Pakistan and because there has never been any substantial research done on the language's sounds or sound system.120 distinct words from various Balti novels were chosen in order to categorize Balti sounds. Using the program PRAAT, the acoustic analysis of Balti consonants has been examined to demonstrate their physical characteristics.

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