

Voice Quality Enhancement through Yogic Breathing Techniques: The Effect of *Ujjayi* and *Bhramari Pranayama*

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ABSTRACT

The human voice is remarkable reflection in an individual; this potential of human being makes unique variance among other living creatures. The human voice contemplates its own personality, gender, age, emotions and other indication. The potential that human voice has to inspire, create emotion and integrate people from different context of life. For professional voice users, such as singers, actors, teachers, radio jockeys, news readers, etc., voice governs their livelihood and for public benefit. Therefore, a productive voice is a goal worth further. The process of modifying the voice includes training the vocal fold muscles and other structures and mechanisms involved in voice production. It also requires good coordination of brain/mind and body. Among various pranayama, *Ujjayi Pranayama* where the breath is felt from the throat to heart and produces a sonorous sound. *Bhramari pranayama* involves both humming and respiration. so, as a consequence of vocal structural activity, which could impact vocal quality. Hence, in the present study we have chosen *Ujjayi* and *Bhramari pranayama* as an intervention to weigh up its effect on voice quality.

Key Words *Ujjayi pranayama, Bhramari pranayama, Voice quality, Respiration, Vocal structures*

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INTRODUCTION

The human voice is extraordinary and it is the mirror of oneself; it is the faculty that renders Man a unique distinction amongst other living creatures. Human voice reflects one's own personality, gender, age, personality, emotions and other gestures. A good voice is the basic need of humans, as it fetches a status in the society thereby determining the social success,

individual professional success and advancement.

For professionals who utilize their voices, such as actors, singers, professors, radio hosts, news readers, and others, their voice determines their social appeal and means of subsistence. Hence an effective voice is a goal worth pursuing a pleasant, beautiful and authoritative voice¹. This depends on interconnected imperatives like

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Vibration, closure and lubrication linked to the vocal fold vibration and resonance².

As a sensory-motor phenomenon, singing calls for certain, well-balanced physical abilities like breathing, phonation, resonance, and articulation. It's a science and art that requires the precise synchronization of all speech subsystems in a systematic manner. It also varies for every style and range of musical tones. These abilities are frequently acquired through singing practice and training, which results in differences between the physiological, acoustic, and perceptual characteristics of singer's voices and those of non-singers³.

Singing, which was a rare professional once, has now gained a wide popularity in present day and is chosen as a prime profession by the aspirants. But it is an art which is to be mastered by rigorous practise so that the voice gets modulated according to the need of the aspirant of different clans of vocal music. The process of voice modulation involves training of vocal muscles and other structures and systems involved in the production of voice. It also needs a perfect co-ordination of brain and body⁴.

"In Ayurveda, *Swasthavritta* and Yoga are regarded as the principal branches aimed at the preservation of health and prevention of diseases, emphasizing holistic lifestyle practices and mind-body discipline." Similarly, Yoga also a science and an art which requires perfect co-ordination of mind and body. Yoga is one of the six ancient Indian systems of medicine and one of six classic schools in Indian philosophy,

having its effect at five different levels i.e. physical, mental, emotional, spiritual and intellectual level, which all together indicate positive health. *Pranayama*, one of the limbs of *Asthanga yoga*, is a practice of regulating the *prana* (vital force), which governs the body. Various studies on different *pranayama* have shown significant improvement on cognitive function⁵, IQ level, respiratory functions⁶, cardiovascular parameters⁷.

Ujjayi and *Bhramari Pranayama*, is believed to have many beneficial effects on the human physiology like pulmonary functions⁸⁻⁹, cardiovascular functions⁹⁻¹¹ and cognitive function which are supported by clinical research. In the act of breathing, humming (one of the attributes of vocal music) is a phenomenon occurring due to the resonance of air in the passages of head, throat, and chest. To add and hasten the process of mastering over vocal music, vocal exercises along with vocal training is a must.

Voice quality may be enhanced by *Ujjayi pranayama*, which produces a calming and strong melodic texture. *Ujjayi pranayama* is accessible to all, and it may be especially beneficial for those who frequently utilize their voices in their line of work. Singers, actors and teachers may be less likely to develop vocal issues if they regularly practice *Ujjayi pranayama*. However, more research is needed to determine whether *Ujjayi pranayama* can enhance voice quality.

Bhramari Pranayama may cause some alterations to the voice cords and local structures because it controls breathing and involves

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humming. Though few research reports available on improvement in voice quality after *Bhramari Pranayama* still it was not well established. There haven't been any studies done on this topic yet. Therefore, the goal of this study is to assess how *Ujjayi* and *Bhramari Pranayama*, if used as a vocal workout, can improve the quality of a prospective vocalist's voice.

MATERIALS AND METHODS

PRANAYAMA

Life comprises the body, which perceives and acts; the mind; the intellect; the ego; and the soul. The mind serves as a link between body and soul. The mind is something that cannot be perceived or touched. *Pranayama* that links the body and mind. It entails purposefully prolonging the inhale, retention, and exhale. The main cause of life is *Prana* or *Vayu*. It is identified with the. He who masters his breathing can master his thoughts. Breathing is one of the gross-level functions that *prana* regulates¹². The fourth stage of *Ashtanga yoga* is *Pranayama*, where the breathing is regulated involuntarily to control the process of the *prana vayu*. The method triggers the essential energy.

Definition

Two words, 'Prana' and 'Ayama', are combined to form the term *pranayama*. *Prana* represents the life force or *Vayu*. *Ayama* signifies to extend or stretch. *Pranayama* involves extending and controlling the breath¹³. Patanjali defines it as the

regulated inbreathing and outbreathing while maintaining a stable position.

Stages of Pranayama¹⁴

There are three stages involved in practicing *Pranayama*.

1. *Puraka* (Inhalation)
2. *Kumbhaka* (Retention)
3. *Rechaka* (Exhalation)

Kumbhaka is further divided into *Bahirkumbhaka* (breath retention after exhalation) *Antarkumbhaka* (Breath retention after inhalation) and *Kevala kumbhaka* (spontaneous breath retention). Yogi practices this as an advanced level of meditation. The practice of the three stages of *Pranayama* should be proportional to the classification of the *pranayama* as *Pravara*, *Madhyama*, or *Avara*. Each stage has specific lakshana mentioned.

Importance of pranayama.

- The mind is unstable, restless, always moving. *Vata* (the *doṣha* governing movement, air element) is also unstable and moving. If *vata* is steadied, the mind too becomes steady. Therefore, by controlling *vayu* (through *pranayama* and other yogic practices), the yogi attains stability and firmness of mind¹⁵.
- As long as *vayu* (the vital breath, *prana*) remains in the body, so long, life (*prana*) is maintained. Death occurs when this *vayu* leaves the body. Therefore, the yogin should learn to control (*nirodha*) this *vayu* through *pranayama*¹⁶. Table 1 shows classification of *Pranayama* along with its Lakshana¹⁷

Pre-requisites for Pranayama¹⁸

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Table 1 Classification of *Pranayama* along with its *Lakshana*¹⁸

	<i>Puraka</i>	<i>Kumbhaka</i>	<i>Rechaka</i>	<i>Lakshana</i>
<i>Avara</i>	12	48	24	<i>Sveda</i>
<i>Madhyama</i>	16	64	32	<i>Kampa</i>
<i>Pravara</i>	20	80	40	<i>Sthana</i>

Acharya Gheranda outlined the requirements necessary to perform *Pranayama*. Important precautions are *Sthana*, *Kala*, *Pathya-Apathya*, and *Nadishuddhi*.

Sthana (Place for practicing):

The individual should steer clear of locations that are distant from their residence, as well as those that are forested, urbanized, or crowded. *Padmasana*, *Siddhasana*, or any *Dhyanatmaka* Posture are the usual positions for practicing *Pranayama*. It can also be practiced in *Sukhasana*.

Kala (Time of practicing *Pranayama*):

Morning, midafternoon, evening, and mid night are considered as the ideal time for practice of *Pranayama*¹⁹.

Pathya-Apathya²⁰

At the initial practice stage, it is advised to consume food made of ghee and milk. Once established in the practice, such restrictions are unnecessary.

The *Gheranda Samhita* states that food should be consumed two times a day: once at midday and once in the evening. The stomach must be empty during *Pranayama*. After the practice, food should be avoided for at least half an hour. Food that is nourishing, light, and easy to digest aids in the practice of *pranayama*.

Apathya

Katu (pungent), *Amla* (sour), *Lavana* (salty), *Ushna* (hot) *guna Ahara*, *Harita*, and *Shaka* (green leafy vegetables) should be avoided. *Bhrishta* (fried items), *Dadhi* (curd), *Takra* (buttermilk), *Madhya* (alcohol), *Tala* (palm), and *Panasa Phala* (overripe jackfruit).

Lakshana's of Proper and improper practice of Pranayama

All diseases can be eradicated through the proper practice of *Pranayama*. All diseases can originate from improper practice²¹. The practice of *prana* control is similar to the progressive management of lions, elephants, and tigers. In other cases, the practitioner is ruined²².

Diseases produced by Improper practice of Pranayama

As a result of *Vata's* vitiation, ailments such as hiccups, asthma, headaches, ear and eye pain, among others, arise²³.

Controlling of Prana vayu

The *Vayu* must be skillfully inhaled, expelled, and kept in order to attain perfection, or *siddhi*²⁴.

Mode of action of Pranayama²⁵

Breath is the key indicator of energy within the body, essential for gaining control over that energy. Breathing is controlled by the expansion and contraction of the lungs.

- By downward and upward movement of diaphragm.
- By elevation and depression of the ribs.

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Elastic recoil of the respiratory muscles is causing contraction to occur the pneumotaxic centre, located in the top region of the midbrain, regulates the breathing pattern and rhythm.

The dorsal respiratory group in the medulla is responsible for inspiration, while a ventral respiratory group of neurons manages expiration. However, the overall activity level of the respiratory centre is regulated to align with the body's ventilatory requirements. There are two different ways to achieve this.

(1) Through the enhancement of respiratory centre activity based on alterations in the chemical makeup of the blood, particularly regarding levels of carbon dioxide, hydrogen ions, and oxygen. (2) Through excitatory signals originating from different regions of the nervous system. The blood's chemical composition varies according to the body's metabolic activity. The whole energy demand is satisfied through bodily metabolic processes. All physical and mental functions are performed at the expenditure of energy. Prana is the energy that propels each of these processes. Therefore, the prana can be controlled by the breathing regulations. Prana governs the body's whole physiology. Consequently, the mind is also controlled.

The concept of disease in yoga provides a detailed explanation of the mind's involvement in physical ailments. This clearly indicates that our ancient seers had a good understanding of the pathogenesis of psychosomatic ailments. There is also a broad consensus, supported by evidence, that yoga serves as an effective preventive and

management tool for stress-induced disorders²⁶⁻²⁷.

UJJAYI PRANAYAMA

- The term "victorious breath" refers to the practice of controlling one's breath to achieve success. It is one of the *Ashtha kumbhakas*.
- The root *ujji* signifies "to conquer" or "acquire by conquest." Because of its mental impact, *Ujjayi* is referred to as the "psychic breath" in English²⁸. This *pranayama* happens on its own as attention becomes intense and profound, even though it is explained here as a specialized technique. Because *Ujjayi* is so easy to perform, it can be done anywhere and in any position.

Definition:

Close your mouth and take a controlled, focused breath through *ida* and *pingala*, making sure the sound is sonorous and felt from the throat to the heart. Exhale through *ida* after performing *kumbhaka*²⁹.

Synonyms:

Ujjayi Kumbhaka

Functions:

- In addition to clearing the throat of phlegm and igniting the digestive fire, it also eliminates dropsy and *nadis* and *dhatu* problems.
- *Ujjayi* is frequently used in conjunction with mantra recitation, such as *soham*, *hamso*, or *japa* on your guru mantra. Because it promotes mental and physical relaxation, increases psychic sensitivity, and cultivates awareness of the subtle

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body, it is utilized in meditation, *kriya yoga*, and *yoga nidra*²⁹.

Methods of Practice of Ujjayi Pranayama³⁰

Technique 1.

- Sit comfortably in a contemplative position (As shown in figure 1). Feel the air move through your windpipe and become conscious of your natural breathing pattern.



Figure 1: *Padmasana* Position.

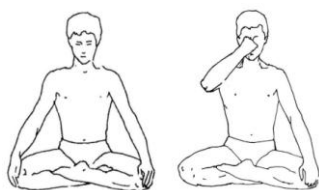


Figure 2: *Ujjayi pranayama*.



Figure 3: *Shanmukhi mudra*.

- The area at the back of the throat should be slightly contracted, just like when you swallow. A slight snoring sound is produced by a partial contraction of the glottis, which occurs during inhalation and expiration through the nose. The sound must come from the throat rather than the nose via force.
- Use both nostrils to take a deep breath, then do internal breath retention. Close your right nostril and only exhale through your left (As

shown in figure 2). Engage in full yoga breathing exercises while focusing on the sound.

- The same pattern should be followed for nine cycles.

Figure 1: *Padmasana* Position.

Figure 2: *Ujjayi pranayama*.

Technique 2.

- Sit comfortably in shavasana or any contemplative pose. Feel the air moving through your windpipe and become conscious of your natural breathing pattern.

- Swallowing should cause the back of your throat to slightly tighten.

- A small snoring sound is created by a partial contraction of the glottis, even if the nose is used for inhalation and exhalation.

- The sound must originate in the throat rather than being driven via the nose.

- The *khechari mudra* is absorbed by folding the tongue back such that the tip presses on the back of the soft palate.

- Take a deep inhale through both nostrils, practice internal breath retention, and then close your right nostril and only exhale through your left.

- Focus on the sound while engaging in full yogic breathing.

- The same should be done for nine cycles.

Technique 3.

- Sit in a meditative position and become ready for meditation.

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- Recognize how the body naturally breathes and experience the air moving through the windpipe.
- As you swallow, slightly tighten the back of your throat. A small snoring sound is created by a partial contraction of the glottis, even if the nose is used for inhalation and exhalation. The sound must originate in the throat rather than being driven via the nose.
- To execute *jalandhara bandha*, hold your breath after inhaling, close both nostrils with your right hand, and then lower your head. Lift the head, release the *jalandhara*, and exhale slowly via the left nostril exclusively while using *ujjayi*.
- The same should be done for nine cycles.

Technique 4.

- Sit in a meditative position and become ready for meditation.
- Recognize how the body naturally breathes and experience the air moving through the windpipe.
- As you swallow, slightly tighten the back of your throat.
- A small snoring sound is created by a partial contraction of the glottis, even if the nose is used for inhalation and exhalation. The sound must originate in the throat rather than being driven via the nose.
- To absorb the *khechari mudra*, fold the tongue back until the tip meets the back of the soft palate.

- In order to conduct *jalandhara bandha*, hold your breath after inhaling, close both nostrils with your right hand, and then lower your head. Lift the head, release the *jalandhara*, and exhale slowly via the left nostril exclusively while using *Ujjayi*.
- The same should be done for nine cycles.

General Benefits of Ujjayi Pranayama:

Physical benefits:

- Nervous, digestive, and kapha imbalance diseases do not show symptoms.
- *Ama vata*, TB, fever, respiratory conditions, and spleen-related problems are among the illnesses that have been treated.
- Old age and death are also controlled if *Ujjayi kumbhaka* is perfected.
- *Ujjayi pranayama*, which creates a soothing and powerful melodic texture, can improve voice quality³¹.

Mental benefits:

It has profoundly relaxing effect at psychic level. It helps to relieve insomnia and may be practiced in *shavasana*³².

BHRAMARI PRANAYAMA

A form of pranayama known as *Bhramari Pranayama* gets its name from the black Indian bee of the same name. Among the *Ashtha kumbhakas* this is one.

Nirukti:

The Sanskrit word "*Bhramari*" refers to a female bee³³.

Definition:

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A yoga breathing method called *Bhramari Pranayama* simulates the buzzing of a female bumble bee by creating a vibrating, steady-pitched sound. The male black bee's reverberating sound is produced by inhaling rapidly, whereas the female black bee's sound is produced by exhaling slowly and softly. This yogic practice immerses the mind in joy and makes one the lord of yogis³⁴.

Synonyms:

Bhramari Kumbhaka

Time of Practice³⁵:

Traditionally, *pranayama* should be done before meditation or bedtime, and after *asana*, *nadi shodhana*, and other active kinds of *pranayama*. The best times to practice are late at night or in the early morning when you are not hungry.

The Gheranda Samhita states that *bhramari kumbhaka* should be practiced after midnight when there is less noise in the surroundings.

Methods of Practice of Bhramari Pranayama³⁴:

Technique 1.

- Select a comfortable position for meditation, then relax and perform *Kayasthairyam*.
- The eyes should stay closed during the entire exercise.
- Slowly inhale through your nose, listening to the sound of your breath.
- The middle outside portion (Tragus) of the ear ligament should be pressed into the ear opening with the index fingers to close the ears (As shown in figure 3).

- While exhaling should produce a deep, quiet humming sound. Once the exhale is finished, bring the hands down to the knees and take a calm, deep breath.
- For 9 cycles, the same should be practiced. One should focus on the sounds made during the exhalation while keeping their eyes closed.

Figure 3: *Shanmukhi mudra*.

Technique 2

- Select a comfortable position for meditation, then relax and perform *Kayasthairyam*. Keep your eyes closed during the entire practice.
- Inhaling gently via the nostrils while paying attention to the sound of the breath is recommended.
- The middle outside portion (Tragus) of the ear ligament should be pressed into the ear opening with the index fingers to close the ears (*Suchi mudra*).
- Exhaling should produce a deep, quiet humming sound.
- Following the completion of the exhale, one should execute *moola bandha*, *jalandhara bandha*, and *bahir kumbhaka*.

- For 9 cycles, the same should be practiced. One should focus on the sounds made during the exhalation while keeping their eyes closed.

Technique 3:

- Close your eyes.
- With the elbows pointed outward in alignment with the shoulders, place both hands on the face.

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- To close them, place the thumb on the tragus of the ear. Then, place the index and forefingers on the closed eyes, lightly touching the inner corners. Then, place the middle fingers on either side of the nose (nasal ala), the ring fingers above the mouth, and the little fingers at the corners of the mouth. This is called *Shanmukhi mudra*.
- Concentrate on the sound of the air being inhaled as you take a slow, deep breath through your nose. To the best of your ability, hold your breath (Kumbhaka).
- Exhale while holding your hands in the same posture for as long as you can, humming like a bee. One cycle is created by the inhalation, withholding, and exhalation of breath.
- Focus on the faint noises that ring in the head, neck, and face.
- For 9 cycles, repeat the same thing.

Effects during the practice of Bhramari pranayama³⁵:

Following practice, the right ear will first hear sounds that sound like crickets, then *vamshi* (flute), *megha* (thunder), *bhramara* (bee), and a variety of musical instruments like *turahi*, *bheri*, *mrudanga* (double-headed drum), etc.

General Benefits of Bhramari Pranayama:

Mental benefits³⁵: It increases psychic sensitivity and vibration awareness. Reduces worry and stress in the mind, reduce anger, enhances focus, and brings mental calm.

Physical benefits:

specific vibratory effect on the body's tissues, particularly the brain, which stimulates different brain centres³⁶. Enhances the voice's sweetness. Therefore, singers benefit the most³⁷. It improves and strengthens the voice and heals throat ailments³⁸.

Spiritual Benefits³⁹:

It is stated that the *Anahata* (pectoral) area experiences the *Brahma jyoti*, which is a resonance or aura, after hearing different sounds. Focusing on this spot brings to a state of happiness that is comparable to touching Lord Vishnu's sacred feet. One achieves the state of *Samadhi* through *Siddhi* in *Bhramari Pranayama*.

DISCUSSION

Discussion on the Probable Mode of Action of Ujjayi Pranayama.

Ujjayi Pranayama is practiced by constricting the glottis during inhalation and exhalation, producing a soft hissing or ocean-like sound. The process of creating sound vibrations in the throat and regulating breath with awareness is thought to exert multiple beneficial effects on body and mind.

Probable mode of action of Ujjayi Pranayama by Chakra Stimulation:

Ujjayi Pranayama is practiced by consciously constricting the glottis to produce a soft, ocean-like sound during both inhalation and exhalation. This controlled sound vibration is localized at the

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level of the *Kantha* (throat) and hence is primarily associated with the *Vishuddha chakra*.

- *Vishuddha chakra (Kantha chakra):*

Located at the throat, it is believed to govern voice, communication, expression, hearing, and the functions of the thyroid and parathyroid glands. In yogic texts, this chakra is considered to vibrate at a particular frequency which harmonizes with the *swaras* (musical notes). By repeated stimulation through *Ujjayi* sound, *Vishuddha chakra* is thought to be activated, thereby enhancing voice clarity, resonance, and communication ability⁴⁰⁻⁴².

- *Anahata chakra (Hrudaya chakra):*

During deep inspiration with chest expansion in *Ujjayi*, the *Anahata chakra* is also stimulated. This chakra governs circulation, respiration, and emotions like compassion and creativity, all of which are essential for expressive singing⁴¹⁻⁴².

Thus, in the context of vocalists, *Ujjayi Pranayama* may work through synchronization of *Vishuddha* and *Anahata chakras*, improving *Madhyama shabda* (quality of voice) which later manifests as *Vaikhari* (clearly articulated speech or song).

Probable Mode of Action *Ujjayi Pranayama* on Nervous System

The hallmark of *Ujjayi* is the slow, deep breathing with glottic resistance. This modifies the sensory feedback from the upper airway and lungs:

- The audible sound acts as an auditory biofeedback loop, heightening awareness of breathing and voice production.

This constant feedback improves neuromuscular control over phonation.

- *Ujjayi* enhances alpha and theta brain wave activity (Jerath et al., 2006), which is linked with relaxation, improved focus, and heightened creativity — qualities essential for singers.

- The prolonged exhalation with sound may entrain neural oscillations in the auditory and vocal-motor cortex, improving cortical integration of breath, sound, and vocal control⁴³.

This regulation of nervous activity may be explained as the *samyak gati* (harmonious flow) of *Vata dosha*, particularly *Prana* and *Udana Vayu*, which are primarily involved in respiration, speech, memory, and higher intellectual functions⁴⁴⁻⁴⁵.

Probable Mode of Action *Ujjayi Pranayama* on Autonomic Nervous System (ANS)

Ujjayi Pranayama provides a gentle resistance to airflow at the glottis, which increases intrathoracic pressure and stimulates baroreceptors and vagal afferents. This results in:

- Enhanced parasympathetic activity (vagal tone), as evidenced by reduced heart rate and blood pressure, and increased heart rate variability (Pal et al., 2004; Bhavanani et al., 2011).

- Balanced autonomic outflow, reducing sympathetic overactivity, stress, and anxiety, while promoting calmness and mental stability.

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For vocalists, this is particularly important since the vagus nerve gives rise to the recurrent laryngeal and superior laryngeal nerves, which supply the vocal cords and laryngeal muscles. Thus, stimulation of vagal activity by *Ujjayi* may improve motor coordination of vocal muscles, endurance, and voice modulation⁴⁶⁻⁴⁷.

Ayurvedically, this is explained as regulation of *Vata dosha* through control of *Vayu*, leading to balanced function of *manas* (mind) and *indriyas* (sense-organs)⁴⁴⁻⁴⁵.

Probable Mode of Action of *Ujjayi Pranayama* on Respiratory System

The respiratory benefits of *Ujjayi* are both mechanical and physiological:

- The glottic narrowing during inspiration and expiration increases airway resistance, thereby strengthening the respiratory musculature (diaphragm, intercostals, accessory muscles).
- Prolonged inhalation and exhalation increase tidal volume, vital capacity, inspiratory reserve volume, and improve pulmonary compliance.
- Several studies (Sivapriya et al., 2010; Bhavanani et al., 2011) have demonstrated significant improvements in FEV1, FVC, PEF, and MVV after regular practice of *Ujjayi Pranayama*⁴⁷⁻⁴⁸.

In voice physiology, efficient respiration is the foundation of sustained phonation. Improved breath control translates into better pitch stability, prolonged note holding, and improved vocal stamina.

This can be explained as the strengthening of *Prana Vayu* (responsible for respiration, sensory perception, and higher cognition) and *Udana Vayu* (responsible for speech, enthusiasm, and effort). Harmonization of these *vayu* supports both respiration and vocal production⁴⁴.

Additional Voice-Specific Effects

- The audible ocean-like sound of *Ujjayi* helps practitioners train their voice modulation in a graded and controlled manner, acting as a preparatory exercise for vocalists⁴⁰⁻⁴¹.
- Continuous practice lubricates and conditions the vocal folds through regulated airflow, potentially preventing strain or fatigue⁴⁰.
- By reducing anxiety and improving parasympathetic tone, *Ujjayi* helps maintain a steady, confident, and emotionally expressive voice during performance⁴⁶⁻⁴⁷.

Discussion a probable mode of action of *Bhramari Pranayama*:

Bhramari Pranayama includes the act of humming while exhaling. The process of humming is thought to produce beneficial effects on the body, a notion supported by yogic explanations of *Bhramari Pranayama's* mode of action and several contemporary studies examining its effects on the nervous and respiratory systems.

Probable mode of action of *Bhramari Pranayama* by *Chakra Stimulation*:

- In the human body, the *prana* (vital force) is harnessed at six foci called "*Chakras*" along the spinal column. Each *chakra* is believed to be associated with specific organs and systems

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carrying out specific functions, by vibrating at their own rate and velocity. In the present study, the *chakra* concerned is the *vishuddha chakra* (*kantha chakra*) and *anahata chakra* (*hrudaya chakra*), located at the region of throat and chest respectively, *Vishuddha chakra* is believed to be associated with laryngeal nerve plexus, vocal cords, mouth, ears, thyroid, parathyroid gland and *Anahata chakra* with respiratory, circulatory and achievement of goodness⁴⁹.

- Humming is a type of *nada* (sound). In the present study we may compare humming to *nada yoga*. *Nada* yogic exercises address the *chakras* (energy-centers) of the human body by means of natural sound vibrations in the breath. The practice synchronizes *chakraasthanas* (location of chakras) with *swarasthanas* (locations of musical notes).
- Thus, we may infer that, constant humming in this study, must have stimulated and enhanced the frequency of vibration of *vishuddha chakra* and *anahata chakra* which lie at the level of *Kantha*(throat) and *hrudaya* (pectoral region). These *chakras* are believed to improve the voice and respiration leading to the production of good quality of *Madhyama shabdha* (voice) at *kantha*, which attains clarity as a *Vaikhari* (voice proper), in the form of good singing voice.
- Patel et al explain that *Vata dosha* typically has an excess of flow through the *Anahata* and *Vishuddha chakra*, *Pitta dosha* typically shows an excess flow through the *Manipura chakra* and The *Kapha dosha* is often associated with

increased flow through the *Mooladhara* and *Svadhithana chakras*⁵⁰.

- By *pranayama*, the *vayu* is regulated. In the present study, by the practise of *Bhramari Pranayama*, the streamlined *vayu* must have flown through *vishuddhu* and *anahata* chakra, stimulating them leading to the improvement in voice quality.

Probable Mode action of *Bhramari Pranayama* on Nervous System:

- Vialatte et al, found that resonating and repetitive effects of *Bhramari Pranayama* increase the theta activity in the brain generated by theta waves. In older children and adults, cortical theta rhythm appears in deep meditative stages. Many benefits like, high levels of creativity, immunity, enhanced learning ability and deep levels of relaxation are attributed to theta wave activity⁵¹.
- **High levels of Creativity⁵²:**
Theta brain wave dominance is seen in highly creative individuals like artists, musicians, inventors etc. This quality of developing creativity is due to the 3-8Hz of brain waves in the entire range of theta waves.
- **Learning abilities⁵²:**
Learning ability is one of the important functions of theta waves which allows people to learn large amount of information in a short duration. Studies conducted on language learning and development showed that children tend to learn the new languages much quicker than adults, as they are endowed with more theta waves.

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- **Emotional connection⁵²:**

- Theta waves are associated with ability to feel and understand the emotions in a better way. In singing, feeling the emotions contributes to the quality of voice. Since previous studies establish the enhanced theta activity by practice of *Bhramari Pranayama*, in the present study we may infer that humming must have increased the theta activity thereby improving the creative skills like singing, enhanced the ability of learning/ mastering singing and by enhancing the emotional connection in the subjects which is witnessed by the improvement in the quality of voice in the study subjects.

Probable mode of action of *Bhramari pranayama* on Autonomic Nervous System:

- *Bhramari pranayama* is believed to stimulate the Autonomic nervous system by enhancing the parasympathetic activity. A study conducted by Srivastav et al (2017), found that *Bhramari Pranayama* stimulates the reflex of Autonomic Nervous System by increasing the level of noradrenalin, which helps to decrease the level of neuro-hormones responsible for various stresses, anxiety and aroused mental state in deeper Form through bio-feedback mechanism⁵³.

- M. Kuppaswamy et al (2016), conducted a study on understanding the immediate effects of *Bhramari Pranayama* on resting Cardiovascular Parameters in Healthy adolescents and found that five cycles of *Bhramari pranayama* produced a relaxed state and, in this state, parasympathetic

activity overrode the sympathetic activity and concluded that *Bhramari pranayama* improves the resting cardiovascular parameters by stimulating the parasympathetic activity⁵⁴.

- Jain G et al (2011), conducted a study and concluded that *Bhramari Pranayama* probably relaxes the cerebral cortex (supported by the presence of gamma waves) and increases the parasympathetic predominance. The study also proposed that practise of *Bhramari* reduces SBP, DBP and mean arterial pressure (MAP); brings a decline in respiratory rate, increase in tidal volume and thoracic expansibility." Larynx- the voice box is supplied by recurrent laryngeal nerve and internal laryngeal nerve which are concerned with the motor functions (movement of the vocal muscles) and sensory functions of larynx respectively, leading to voice production. These nerves are the branches of Vagus nerve the 10 cranial nerves, which sees its origin from the parasympathetic division of ANS.

Since previous researches have established that *Bhramari Pranayama* improves the parasympathetic activity, we can infer that in present study *Bhramari Pranayama* might have brought improvement in the quality of voice by enhancing the functions of vagus nerve and its branches which are the part of parasympathetic nervous system.

Probable Mode of action of *Bhramari Pranayama* on Respiratory system:

- The sites of *Udana* and *prana vayu* are *uraha, kantha, nasika, nabhi, puphusa, murdha, jivha* and their respective functions are *vak*

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pravrutti, prayatna, orja, gana, bhashana, uchwasa -nishwasa, dharana of buddhi, indriya, chita, and mano-smriti bhodana.

- Also, many studies have established that a continuous practice of *Bhramari pranayama* significantly improves the pulmonary functions FVC FEV1, FEV1/FVCratio, FEF 25%-75% and PEFr, Slow vital capacity (SVC) and Maximum Voluntary Volume (MVV)⁵⁴.

By the above-mentioned sites, we can assume that *Ujjayi* and *Bhramari Pranayama* stimulating the *udana* and *prana vayu*, thereby enhancing their *karma* and improving the voice quality. Since the fact of pulmonary function improvement is established, we can thus infer that in the present study, the voice improvement in terms of quality and vocal prolonging may also be due to the good respiratory functions as respiration also contributes in voice production and the quality of the produced voice.

CONCLUSION

Ujjayi Pranayama which produces a calming and strong melodic texture. *Bhramari Pranayama* which involves a constant humming during exhalation, both might have bring the resonance effect in the oral cavity and nasal cavity, which was reflected by the highly significant improvement in the voice quality.

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