

# EXPLORING KATAPAYADI NUMERALS: INSIGHTS AND APPLICATIONS IN ANCIENT INDIAN WISDOM

**Namothisha Girijan**

Junior Research Fellow  
Department of Sanskrit  
Sngs College, University of Calicut  
Kerala, India  
Email: eduonnamo@gmail.com  
PH.8547577529

## Abstract

The Katapayadi system is an ancient Indian numerical notation that assigned numeric values to letters. This system helps memorize unique numbers and is used for mathematical calculations and other fields. This study explores the origin, principles, and applications of the Katapayadi system in ancient Indian wisdom. This exploratory study contributes to our understanding of ancient Indian wisdom, and highlights the significance of the katapayadi system in various domains.

**Keywords:** Katapayadi system, Ancient Indian wisdom, Numerical notations, Indian numerals, Indian number system

## INTRODUCTION

In ancient India, there was a practice of using letters and words instead of numbers for calculations, counting, and representing days, etc. Among these, Aryabhatiya, Bhutavidya, and Katapayadi stand out as prominent number systems.

Katapayadi was an ancient Indian method of expressing numbers using Sanskrit letters. Although evidence of its use exists elsewhere, the Katapayadi system has its strongest roots in South India, especially in Kerala. This system comprises four groups: Ka, Ta, Pa, and Ya. Each group contained numbers from 1 to 9 and 0. The first letters of all four groups are ka, ta, pa, and ya respectively. Hence, these were numbered one in each group. Vararuchi is considered to be the originator of the Katapayadi system. He was considered to have lived in the 4th century<sup>1</sup>. Who composed an astronomical text, Chandravakyam, in which he used the Katapayadi system for astronomical calculations. In the seventh century, Haridatta used the same system in his texts, but it was also known by a different name. Later, in the 14th century, Madhava of Sangamagrama, the founder of the Kerala School of Astronomy and Mathematics, used this system in his text Venuaroha. Since then, many people have used this system in their work.

## BASICS OF KATAPAYADI SYSTEM

This is the practice of using letters instead of numbers, and each letter has an exact numerical value. Each letter is numbered as given in the table below

1	2	3	4	5	6	7	8	9	0
क	ख	ग	घ	ङ	च	छ	ज	झ	ञ
ट	ठ	ड	ढ	ण	त	थ	द	ध	न
प	फ	ब	भ	म					
य	र	ल	व	श	ष	स	ह		

As shown in the table, each consonant has a value.

- Rules of the Katapayadi system

The following verse is taken from Shankaravarman's Sadratnamala, which clearly states how to use the Katabayadi system and what the rules are.

नजावचश्च शून्यानि संख्याः कटपयादयः।  
मिश्रे तूपान्त्यहल् संख्या न च चिन्त्यो हलस्वरः॥<sup>2</sup>

<sup>1</sup> Joseph George Gheverghese, A Passage to Infinity Medieval Indian Mathematics From Kerala and its Impact, p.12

<sup>2</sup> K V Sarma(Ed.), Sadratnamala of Sankaravarman, p.22

1. The value of न and ञ is zero
2. Vowels standing independently or as first syllables will have a zero value.
3. Vowels that are not the first syllable have no value.
4. If the two consonants are combined, the value of the last consonant should be considered.
5. The number should be read from right to left according to the rule 'अङ्गानां वामतो गतिः'.

For Example

The word फल has 2 letters फ and ल. As per the above table फ=2 and ल=3 Then the result will be 23. When reading from right to left, the result is 32.

Example. 2 शल्य Here 'ल्य' is a letter made up of two consonants ल् and य्. According to the above rule the last consonant of 'ल्य' should be considered. Therefore, the consonant य must be considered. There for

श = 5 & य = 1 Then शल्य = 15

Example.3 उल here उ is a vowel. Vowels have no value in the katapayadi system. However, here, this vowel stands as the first character, so it should be given a zero value according to the rule. There for

उ = 0 & ल = 3

Then उल = 30

## APPLICATIONS IN DIFFERENT FIELDS

- Mathematics and Astronomy

The Katapayadi system is used extensively in mathematical and astronomical texts for calculating the radius of the circle, division, multiplication, etc. Words and sentences are used Instead of numbers for this calculations like 'नानाज्ञानतपोधरः' (29160000)<sup>3</sup> and 'अज्ञाननुत्ने नव चत्वरसंशयः' (157464000000).<sup>4</sup> When it comes to astronomical calculations, various words and phrases such as 'अनंतपुम्' (21600)<sup>5</sup> and 'सचिव' (467)<sup>6</sup> are used in this text for different types of calculations such as planetary positions, their preferred regional conjunctions, etc.

In Sadratnamala written by Sankaravarman, the value of  $\pi$  is structured as follows: 'स्याद् भद्राम्बुधिसिद्धजन्मगाणितश्रद्धा स्म यद् भूषणीः'<sup>7</sup> according to this the value of  $\pi = 314159265358979324$ . Venvaroha is an eminent work composed by Sangamgrama Madhava, who is the founder of Kerala mathematics and astronomy. The entire work was articulated using the Katapayadi system. It states that when the centers of the Moon and Mercury are equal, it is called a Kali day. This day is expressed through the word 'Dinamranusasya:'<sup>8</sup>, which means 15,02,008, the Kali day number.

- Musicology

The Katapayadi system is a significant place in carnatic music. This music is based on seven syllables: sa, ri, ga, ma, pa, dha, and ni. They are known as Shadjam, Rishabham, Gandharam, Madhyam, Pancham, Dhaivatam, and Nishadam. This is called saptaswaras. Changing the positions of these swaras produces different types of ragas. Among vowels, sa and pa are fixed vowels. Ma or Madhyam have two varieties: Shuddhamadhyam and Pratimadhyam. These are denoted by M1 and M2, respectively. Ri, Ga, Dha, and Ni had three variants each. Shuddha Rishabham(R1), Chatusruti Rishabham(R2), Shadsruti Rishabham(R3), Shuddha Gandhara(G1), Sadharana Gandhara(G2), Antara Gandhara(G3), Suddhadhaivatam(D1), Chatusrutiidhaivatam(D2), Shadshrutidhaivatam(D3), Shuddha Nishadam(N1), Kaishiki Nishadam(N2) and Kakali Nishadam(N3) respectively.

'Sa Ri Ga Ma' these swaras can be divided into two, based on Suddhamadhyama and Pratimadhyama. Suddhamadhyama swaras can be arranged in six ways; Similarly, the Pratimadhyamaswaras can be arranged in six ways; thus, Sa Ri Ga Ma can be arranged in 12 manners, which are also called 12 chakras. In the case of 'Pa Dha Ni Sa' it can be arranged into six types, thus we get  $12 \times 6 = 72$  melakarta ragas. Among these ragas, 1 to 36 are called Purvameela ragas, and ragas numbered 37 to 72 are called Uttaramela ragas. The 72 Melakarta ragas were arranged based on the Katapayadi number system. The first two letters of the ragas indicate the number positions of the 72 ragas. The first raga was the kanakangi. The first two letters correspond to Ka and Na. The letter Ka stands for number one in the Katapayadi system, and Na has a value of zero. Consider its reverse order then get 01.

<sup>3</sup> Jyeshthadeva, Yuktibhasha, p.176

<sup>4</sup> Ibid

<sup>5</sup> Ibid, p.283

<sup>6</sup> Ibid, p.163

<sup>7</sup> KV Sarma (Ed.) Sadratnamala of Sankaravarman, p.26

<sup>8</sup> KV Sarma (Ed.), Venuaroha, p.14

• Literature

In Sanskrit literature, the Kadpayadi system has been used elegantly in Kavyas to determine the period of poets and works. The best example of this is the poem Narayaneem written by Melpathur Narayana Bhattathiri. The last line of the last verse in this study is as follows. 'स्फुरितं लीलावतरिदिदिमिह कुरुतामायुरारोग्यसौख्यम्'<sup>9</sup> in this line he is referring to health and happiness by the word ayurarogyasaukhyam, it also point out that when he is completing his work. The letters in this word Ayuradhyasukhyam is indicated '1712210' that means he is completed his work on the day 1712210 after the beginning of Kaliyuga. By using this system of depicting numbers as letters, he can indicate the period of his work in a way that does not affect the beauty of the poem.

## CONCLUSION

Many works have used the Katapayadi system in southern India. The system helps memorize numerical values easily through words and sentences. play an inevitable role in mathematics, astronomy, carnatic music, and literature. The system is not very popular today, but we can use it as a fast memorizable coding system for memorizing large figured numbers in competitive exams and other studies. So this is still remains a valuable system more than just an old one.

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<sup>9</sup> Melputhur Narayanabhattatiri,Narayaniyam,p.406