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ORIGINAL RESEARCH ARTICLE: EXPERIMENTAL STUDY

PHYSICO CHEMICAL STUDY OF *KAJJALI:* A UNIQUE PREPARATION WITH DIFFERENT PROPORTIONS OF PARADA (MERCURY) AND GANDHAKA (SULPHUR)

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ABSTRACT

Kajjali is Sagandh Niragni Murcchana of Parada. It is used in numerous Rasakalpas as a catalyst and also as a chief ingredient. It is usually prepared by taking equal quantity of Shuddha Parada and Shuddha Gandhaka and triturating it till the mixture becomes jet black as that of Kaajal (Anjana). There are references of Kajjali having proportions of Parada and Gandhaka in 1:1/2, 1:1, 1:2 to 1:6 proportions. Hence to examine expected physico chemical changes the present study was undertaken. The Kajjali becomes more and more acidic on addition of Shuddha Gandhaka in it. The specific gravity shows negligible variation among all samples. The moisture content of Kajjali is less than 0.5% which proves that Kajjali do not contain moisture. The specific gravity of Kajjali ranges from 1.022 to 1.039 and it shows that addition of Gandhaka hardly affects specific gravity.

Key Words: Kajjali, Parada, Gandhaka, Shodhana, Physico-Chemical Analysis

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INTRODUCTION

The *Rasaushadhis* are superior to other *Aushadhis* due to their peculiarities such as better therapeutic activity, palatability, quick onset of action, and smaller dose[1]. *Kajjali* is used in many *Rasakalpas* (mercurial preparations) as catalyst and also as a chief ingredient. Even though *Samagunagandhak Kajjali* is mostly used there are references of *Kajjali* having proportions other than 1:1. Which mainly varies 1:1/2 as in *Gandamala Khandan Rasa*, 1:1 in *Swacchanda Bhairav Rasa*, 1:2 in *Arshakuthar Rasa*, 1:3 in *Jwaragni Gutika*, 1:4 in *Gunja Garbha Rasa*, 1:5 and 1:6 in *Chandrakala Rasa* [1]. In classical texts like *Ayurved Prakash, Bharat Bhaishajya Ratnakara* [2] and *Rasa Tarangini* different proportions of *Gandhaka* and *Parada* are used in *Kajjali* preparations for different indications.

Till today *Kajjali* prepared with different proportions of *Gandhaka* and *Parada* have not been studied in detail. Hence to know the physico-chemical changes expected in *Kajjali* when different proportions of *Gandhak* and *Parada* are added in preparation & its importance. The present study was undertaken on Physico Chemical Study of *Kajjali:* A Unique Preparation With Different Proportions of Parada (Mercury) and Gandhaka (Sulphur).

OBJECTIVES OF THE STUDY

1. Physico chemical analysis of *Kajjali* prepared with different proportions of *Gandhaka* and *Parada.*
2. To assess the changes expected in different samples of *Kajjali* preparaed by 1:1/2, 1:1, 1:2, 1:3, 1:4, 1:5, 1:6 proportion of *Parada* and *Gandhaka.*

Kajjali is explained as one among the 25 *Rasa Bandhas* [3] and is defined as Mercury, when added with sulphur and grounded well to very fine black powder like that of collyrium is called as *Kajjali Bandha*[3].

Kajjali is a *Sagandha Murcchana* of *Parada*[4] and is explained in many classical *Rasagranthas* such as ***Rasa Ratna Samucchaya***[5]**;** *Parada* is processed with *Gandhaka* without adding liquids till it converts into jet black powder that looks like *Kaajal* (*Anjana*) is called as *Kajjali*.

Rasa Tarangini [6]; Adding half the quantity, equal quantity, double quantity etc. of sulphur to mercury and triturating till it converts into black fine powder that looks like *Kaajal* (*Anjana*) is called as *Kajjali*.

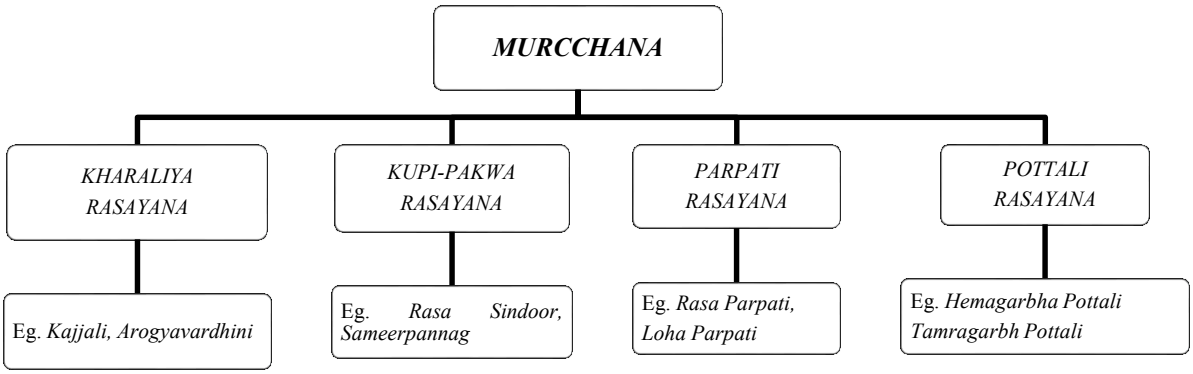
Concept of *Parada Murcchana*:

Mercury is never used alone for internal use. To bring out its therapeutic activity it is used only after processing it with or without sulphur. This conversion is termed as *Murcchana*.

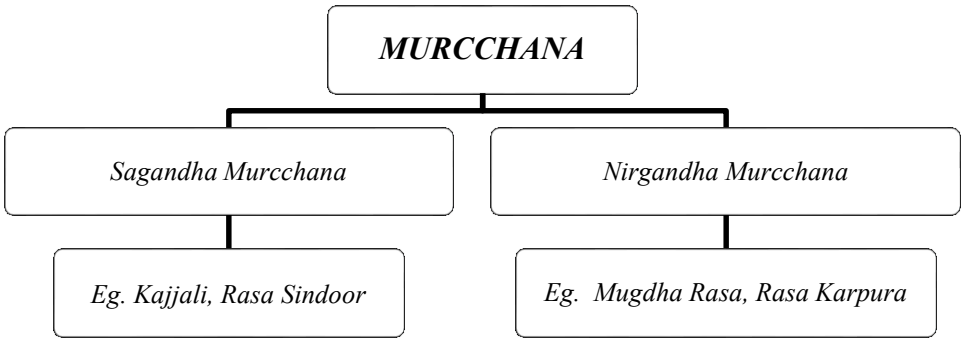
Making mercury to loose its natural form and get it mingled with other drugs to form bolus that is subjected for trituration is called as *Murcchana.* It is also called bringing of

Nastapishtatwa in *Parada* [2]. In other words *Murcchana* is carried out with intension of using *Parada* for therapeutic purpose.

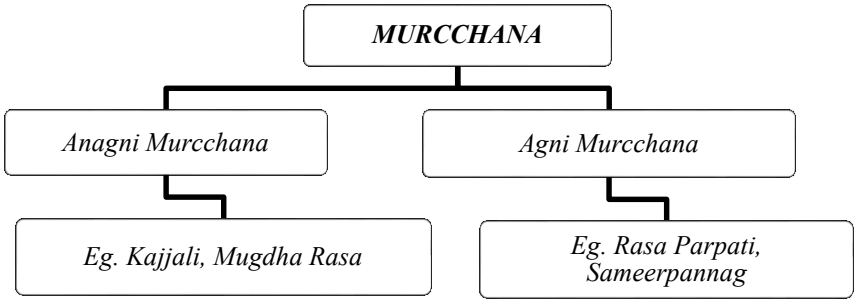
Depending upon the formulation prepared *Murcchana* can be classified as [7]



Depending upon the use of *Gandhaka, Murcchana* can be classified as [4]



Depending upon the use of *Agni* (fire) *Murcchana* can be classified as [4]



Concept of *Kharaliya Rasayana*:-

In this, the mercury is triturated along with other drugs in a *Khalwa*, hence it is termed as *Khalwi Rasayana*[8].

Among all the *Rasakalpas, Kharaliya Kalpas* are more used[8].

General method of *Kajjali* preparation-

At first, *Parada* and *Gandhaka* are purified. Then after proper purification both are taken in the *Khalwi Yantra* in desired quantity and triturated well till the mixture becomes jet black as that of collyrium[6].

***Kajjali Siddhi Lakshanas*[9]**

1. *Slakshnatwa* – fineness
2. *Nischandratwa* – absence of metallic lusture which ensures mingling of mercury into sulphur
3. *Rekha Purnatva* – getting stuck into the minute grooves of fingers when taken with thumb and index finger.
4. *Varitara* – floating on water
5. *Unam* – Rice particle should float on surface of water

The trituration should be continued till above said *Siddhi Lakshanas* are achieved.

Properties of *Kajjali*:-

Guna – *Jantughna, Vrishya, Rasayana*[10]

Doshaghnata *-Tridoshahara*[10]

Indications of *Kajjali*[9]

Kajjali is used along with various *Anupanas* for various indications as mentioned in **Table No.1.**

Table No. 1 :- Indications of *Kajjali* along with its *Anupana*.

Anupana	**Indications**
Powder of *Ela, Marich, Karpur, Musta,Lawang, Badari* seeds	*Vamana* (vomiting)
Varunadi Gana	*Vidradhi* (tumours)
Dwiguna Kajjali + juice of *Karavellak* (bitter guard)	*Visarpa* (erysipelas)
Dwiguna Kajjali (Bhawana of *Vana Tulasi*) + *Yashtimadhu, Haritaki, Vasa, Pippali, Bibhitaki Churna*	*Shwasa, Kasa, Tamaka Shwasa*
Ela Beej, Ahiphena, Karpur, Jatiphala, Lavang	*Swapna Meha*
Kajjali + butter (applied externally)	*Gaja Karna* (skin diseases)
Kajjali + *Saindhav Lavan* + mixed in cows milk (applied externally)	*Gandamala*
Dwiguna Kajjali + cows butter	*Upadansh* (syphilis)
Dhattur Beej Swaras + *Trikatu Churna* (as nasal drops) + *Kajjali*	*Sannipat Jwara*
Kajjali+ sugar + *Amalaki Swarasa*	*Madatyaya*

Dose of *Kajjali*[10]:-

1-2 *Ratti* (125-250 mg)

MATERIALS AND METHODS

Materials:

A. Drugs:

Sample 1: *Kajjali* prepared with 1 part of *Shodhit Parada* and ½ part of *Shodhit Gandhaka*

Sample 2: *Kajjali* prepared with 1 part of *Shodhit Parada* and 1part of *Shodhit Gandhaka*

Sample 3: *Kajjali* prepared with 1 part of *Shodhit Parada* and 2 parts of *Shodhit Gandhaka*

Sample 4: *Kajjali* prepared with 1 part of *Shodhit Parada* and 3 parts of *Shodhit Gandhaka*

Sample 5: *Kajjali* prepared with 1 part of *Shodhit Parada* and 4 parts of *Shodhit Gandhaka*

Sample 6: *Kajjali* prepared with 1 part of *Shodhit Parada* and 5 parts of *Shodhit Gandhaka*

Sample 7: *Kajjali* prepared with 1 part of *Shodhit Parada* and 6 parts of *Shodhit Gandhaka*

B. Equipments :

- Digital pH meter
- Holders
- Hot air oven
- Holders

A. **Glass wares :**

- Test tubes
- Funnel
- Beakers
- Specific gravity bottle
- Petri dish
- Desiccators
- Glass rods
- Pipette

B. Chemicals & Solvents :

- Distilled water
- Ethyl Alcohol
- Methanol
- Acetone
- Xylene
- Toluene
- Benzene
- Carbon tetra chloride
- Petroleum ether
- Chloroform
- HCL

Pharmaceutical Study:

All the above mentioned Seven Samples of *Kajjali* were prepared in the Pharmacy attached to the Dept. Of Rasashastra & Bhaishajya Kalpana, BLDEA'S AVS Ayurveda Mahavidyalaya, Vijayapur, by following all the Standard Operating Procedures (S.O.P.) and *Siddhi Lakshanas* are accessed as below

Standardisation of *Kajjali* as per Ayurvedic Parameters.

Kajjali Siddha Lakshanas are shown in **Table No. 2.**

Table No 2:- Showing *Kajjali Siddha Lakshanas* of all the 6 samples

	Nischandratwa Test	*Slakshnatwa* Test	*Rekhapurnatva* Test	*Varitara* Test	*Unam* Test
SAMPLE 1	+	+	+	+	+
SAMPLE 2	+	+	+	+	+
SAMPLE 3	+	+	+	+	+
SAMPLE 4	+	+	+	+	+
SAMPLE 5	+	+	+	+	+
SAMPLE 6	+	+	+	+	+
SAMPLE 7	+	+	+	+	+

Organoleptic characters:-

Organoleptic characters of all 7 samples are shown in **Table No. 3**

Table No. 3 :- Showing organoleptic characters of all the 6 samples *Kajjali*

SAMPLE	SHABDA	SPARSHA	RUPA	RASA	GANDHA
SAMPLE 1	--------	Shlakshna	Kajjalasam (jet black)	----------	----------
SAMPLE 2	--------	Shlakshna	Kajjalasam (jet black)	----------	----------
SAMPLE 3	--------	Shlakshna	Kajjalasam (jet black)	----------	----------
SAMPLE 4	--------	Shlakshna	Kajjalasam (jet black)	----------	----------
SAMPLE 5	--------	Shlakshna	Kajjalasam (jet black)	----------	----------
SAMPLE 6	--------	Shlakshna	Kajjalasam (jet black)	----------	----------
SAMPLE 7	--------	Shlakshna	Kajjalasam (jet black)	----------	----------

Methods : Physico-chemical analysis : **1) Organoleptic character**

1. Colour
2. Odour
3. Touch
4. Taste
5. Appearance

2)Physical constants:-

1. pH
2. Moisture content
3. Specific gravity
4. Solubility and percentage of solubility
5. Acid and alkaline neutralizing activity

Physico-chemical analysis:

- **Physical constants:-**

pH[11] :-The digital pH meter was used to calculate pH. The reference electrode was thoroughly washed with distilled water every time and wiped by using filter paper. 1% test drug solution (1gm of test drug powder + 100 ml distilled water) was prepared then the tip of electrode was dipped and recorded.

pH of all 7 samples are shown in **Table No. 4**

Table No. 4 :- Showing pH of different samples of *Kajjali*

Sample No.	Ph
Sample 1	8.0
Sample 2	6.8
Sample 3	6.7
Sample 4	6.6
Sample 5	6.3
Sample 6	6.0
Sample 7	5.9

Moisture content[12]:- A clean and dry petridish was weighted. 5gm of dried test drug powder was taken in petridish and weighted. Petridish was kept in hot air ovan for one hour at 105^{o} C. After one hour the petridish containing test drug was taken out from hot ovan and cooled in desiccator and weighted. Again the petridish was kept in hot air ovan for another one hour at 105^{0}C. The procedure was repeated until the constant weight of petridish containing powder was obtained.

Moisture content of all 7 samples are shown in **Table No. 5**

Table No. 5:- Moisture content of different samples of *Kajjali*

Sample No.	Percentage of moisture content
Sample 1	**0.2 %**
Sample 2	**0.2 %**
Sample 3	**0 %**
Sample 4	**0.4 %**
Sample 5	**0 %**
Sample 6	**0 %**
Sample 7	**0 %**

Specific Gravity[13] :-

An empty specific gravity bottle was weighted. Then the bottle was filled with distilled water and again weighted. The same bottle was then filled with 1% (100ml H20+1gm of test drug powder) and weighted. All these 3 readings were noted. The specific gravity of samples was calculated according to following formula.

Specific Gravity of all 7 samples are shown in **Table No. 6**

Table No. 6 :- Specific Gravity of different samples of *Kajjali*

ıple No.	Specific Gravity
Sample 1	**1.031**
Sample 2	**1.027**
Sample 3	**1.021**
Sample 4	**1.022**
Sample 5	**1.022**
Sample 6	**1.039**
Sample 7	**1.022**

Solubility Test[14]:-

A pinch of test drug was taken in a dry test tube with 1 ml of solvent and shaken for 1 minute and then observed for solubility **(S)**, non-solubility (**NS)** and sparingly solubility **(SS).** The results of solubility tests are shown in **Table No. 7,** all the samples were subjected with the following solvents.

1. Acetone
2. Carbon tetra chloride
3. Chloroform
4. Distilled water
5. Ethyl Alcohol
6. Methanol
7. Normal Saline
8. Petroleum ether
9. Toluene
10. Xylene

Table no. 7:- Solubility test of different samples of *Kajjali*

Solvent	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
Acetone	NS	NS	NS	NS	NS	NS	NS
Carbon tetra chloride	NS	NS	NS	NS	NS	NS	NS
Chloroform	NS	NS	NS	NS	NS	NS	NS
Distilled water	NS	NS	NS	NS	NS	NS	NS
Ethyl Alcohol	NS	NS	NS	NS	NS	NS	NS
Methanol	NS	NS	NS	NS	NS	NS	NS
Normal Saline	NS	NS	NS	NS	NS	NS	NS
Petroleum ether	NS	NS	NS	NS	NS	NS	NS
Toluene	NS	NS	NS	NS	NS	NS	NS
Xylene	NS	NS	NS	NS	NS	NS	NS

Acid and Alkaline neutralizing activity[15] :-

Three different pH solution of having pH 3.2, 7.1 and 9.2 were prepared. 1gm of test drug was dissolved in 100 ml of each of three pH media. The change in pH of the solutions was monitored at an interval of one hour from the time of addition of test drug up to 12 hours, by

using digital pH meter. The results were tabulated in **Table No. 8,9,10 and 11**

Table No. 8 :- Acid and Alkaline neutralizing activity of *Kajjali* Sample 1 & 2

	SAMPLE 1			SAMPLE 2		
	pH 3.2	**pH 7.1**	**pH 9.2**	**pH 3.2**	**pH 7.1**	**pH 9.2**
At 0 hrs	2.9	6.3	9.1	3.3	5.8	9.2
After 1 Hr.	3.2	6.3	9.0	3.5	5.8	9.2
After 2 Hr.	2.9	6.3	9.1	3.3	5.8	9.3
After 3 Hr.	3.3	6.1	9.1	3.4	5.7	9.3
After 4 Hr.	3.3	6.1	9.1	3.4	5.8	9.2
After 5 Hr.	3.0	6.1	9.0	3.4	5.8	9.1
After 6 Hr.	3.0	6.1	8.9	3.4	5.8	9.0
After 7 Hr.	3.0	6.1	9.0	3.4	5.8	9.1
After 8 Hr.	3.0	6.3	8.8	3.4	5.9	8.9
After 9 Hr.	3.0	6.1	8.8	3.3	5.9	8.9
After 10 Hr.	3.0	6.3	8.8	3.3	5.9	8.8
After 11 Hr.	3.0	6.3	8.8	3.3	5.9	8.8
After 12 Hr.	3.0	6.0	8.7	3.3	6.0	8.8

Table No. 9:- Acid and Alkaline neutralizing activity of *Kajjali* Sample 3 & 4

	SAMPLE 3			SAMPLE 4		
	pH 3.2	**pH 7.1**	**pH 9.2**	**pH 3.2**	**pH 7.1**	**pH 9.2**
At 0 hrs	3.5	6.2	9.2	3.9	6.8	9.3
After 1 Hr.	3.5	6.3	9.3	3.5	6.8	9.3
After 2 Hr.	3.5	6.4	9.3	3.7	6.9	9.3
After 3 Hr.	3.5	6.5	9.3	3.7	6.9	9.2
After 4 Hr.	3.5	6.5	9.2	3.5	6.9	9.2
After 5 Hr.	3.5	6.5	9.1	3.5	7.0	9.1
After 6 Hr.	3.5	6.4	9.0	3.5	7.0	9.0
After 7 Hr.	3.2	6.4	9.0	3.5	6.9	9.0
After 8 Hr.	3.2	6.5	8.9	3.5	6.9	8.8
After 9 Hr.	3.2	6.4	8.9	3.5	6.9	8.9
After 10 Hr.	3.4	6.5	8.7	3.5	6.9	8.7
After 11 Hr.	3.3	6.5	8.8	3.5	6.9	8.7
After 12 Hr.	3.3	6.5	8.7	3.5	6.9	8.8

Table No. 10 :- Acid and Alkaline neutralizing activity of *Kajjali* Sample 5 & 6

	SAMPLE 5			SAMPLE 6		
	pH 3.2	**pH 7.1**	**pH 9.2**	**pH 3.2**	**pH 7.1**	**pH 9.2**
At 0 hrs	3.2	5.8	9.1	3.3	7.0	9.2
After 1 Hr.	3.5	5.7	9.2	3.2	6.7	9.3
After 2 Hr.	3.4	5.8	9.3	3.1	6.8	9.3
After 3 Hr.	3.4	5.9	9.2	3.4	6.7	9.2
After 4 Hr.	3.4	5.9	9.2	3.4	7.0	9.2
After 5 Hr.	3.4	6.1	9.2	3.4	6.9	9.0
After 6 Hr.	3.4	6.2	9.1	3.4	7.2	9.0
After 7 Hr.	3.4	6.2	9.1	3.4	7.2	8.9
After 8 Hr.	3.4	6.3	8.8	3.4	7.3	8.8
After 9 Hr.	3.4	6.3	8.9	3.4	7.0	8.9
After 10 Hr.	3.4	6.4	8.7	3.4	7.1	8.7
After 11 Hr.	3.4	6.4	8.8	3.4	7.2	8.8
After 12 Hr.	3.4	6.5	8.8	3.4	7.1	8.7

Table No. 11 :- Acid and Alkaline neutralizing activity of *Kajjali* Sample 7

	SAMPLE 7		
	pH 3.2	**pH 7.1**	**pH 9.2**
At 0 hrs	3.4	6.9	9.4
After 1 Hr.	3.4	6.6	9.5
After 2 Hr.	3.2	6.7	9.5
After 3 Hr.	3.4	6.5	9.5
After 4 Hr.	3.4	6.8	9.4
After 5 Hr.	3.4	6.7	9.2
After 6 Hr.	3.4	6.9	9.0
After 7 Hr.	3.3	7.0	9.2
After 8 Hr.	3.3	7.1	9.1
After 9 Hr.	3.3	6.9	9.2
After 10 Hr.	3.3	7.1	9.0
After 11 Hr.	3.3	7.1	9.1
After 12 Hr.	3.3	7.0	9.0

DISCUSSION:

To gain complete knowledge of a subject logical, scientific explanations are very

necessary which is achieved through discussion. Here the discussion of physic chemical analysis of *Kajjali* was done. *Rasashastra* is the science dealing with *Parada* (Mercury) and its processing. This is the system that in which there is extensive use of mercury and other metals and minerals for the purpose of *Dehavada* and *Lohavada*. Later it has developed as a separate branch of *Ayurveda* and has blessed with enormous therapeutic benefits.

Parada Murcchana is a process by which *Parada* achieves disease destroying properties. *Kajjali* is *Sagandha Niragni Murcchana* of *Parada* and it is a kind of *Pota Bandha* of *Parada*. Even though contains of *Kajjali* i.e. *Parada* and *Gandhaka* are mentioned in *Bruhatrayis* there is no mention of *Kajjali* in it. *Kajjali* is widely explained in all *Rasa* classics in terms of *Paribhasha*, Dosage, *Anupana,* indications etc.

Kajjali is used alone with several *Anupanas* in several indications and it is also used as part of *Rasakalpas* (mercurial formulations). In *Rasakalpas* it is mainly considered for its catalytic activity yet it possesses several therapeutic efficacy too. *Kajjali* is used by means of oral as well as an external application. Seven samples of *Kajjali* were prepared having proportions of *Parada* & *Gandhaka* as 1:1/2,1:1,1:2,1:3,1:4,1:5,1:6 (termed as Sample 1 to Sample7 respectively). For making each *Kajjali*; at first *Shodhit Parada* was taken in a *Khalwa Yantra* and to it required quantity of *Shodhit Gandhaka* was added. The mixture was triturated well till *Siddhi Lakshanas* like *Shlakshnatwa, Rekhapurnatwa, Vaaritar* were achieved. The prepared samples of *Kajjali* were accessed for physic chemical analysis.

The result are as pH of sample 1 is 8.0, that of sample 2 is 6.8, sample 3 is 6.7, sample 4 is 6.6, sample 5 is 6.3, sample 6 is 6.0, sample 7 is 5.9 which can be interpreted as – *Kajjali* becomes more acidic as the *Gandhaka* content increases. When moisture content was assessed it was <1%, moisture content sample 1 is 0.2%, sample 2 is 0.2%, sample 3 is 0%, sample 4 is 0.4%, sample 5 is 0%, sample 6 is 0%, sample 7 is 0% which shows that *Kajjali* contains very minimal moisture which can be considered as 0%.

Specific gravity test shows results of 7 samples as 1.031, 1.027, 1.021, 1.022, 1.022, 1.039, 1.022 which means the addition of *Gandhaka* minutely affects specific gravity.

The solubility of all seven samples was checked in solvents such as Acetone, Carbon tetra chloride, Chloroform, Distilled water, Ethyl Alcohol, Methanol, Normal Saline, Petroleum ether, Toluene and Xylene which showed that none of the sample was soluble in any of the solvent media and it can interpreted as *Kajjali* is non soluble in said solvents and alteration in

the proportion of *Parada Gandhaka* does not affects solubility.

CONCLUSION:

Seven samples of *Kajjali* were prepared having proportions of *Shodhit Parada* and *Shodhit Gandhaka* as 1:1/2, 1:1, 1:2, 1:3, 1:4, 1:5 and 1:6 which were named as Sample 1, Sample 2, Sample 3, Sample 4, Sample 5, Sample 6and Sample 7respectively.

Kajjali was initially assessed on *Ayurvedic* Parameters (*Siddhi Lakshanas*) and it showed that all samples withstand standards said by *Rasacharyas*. Even though volume of *Kajjali* increases from Sample 1 to Sample 7 there is minimal difference in weight of *Kajjali*.

The *Kajjali* becomes more and more acidic on addition of *Shodhit Gandhak* in it. The Specific Gravity shows negligible variation among all samples of *Kajjali* . The moisture content of *Kajjali* is less than 0.5% which proves that *Kajjali* do not contain moisture; The Specific Gravity of *Kajjali* ranges from 1.022 to 1.039 and it shows that addition of *Gandhaka* hardly affects Specific Gravity.

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