



ORIGINAL RESEARCH ARTICLE STANDARDIZATION OF NARIKELA KHANDA AND NARIKELA KHANDA GRANULES - HERBAL COMPOUND FORMULATIONS OF NARIKELA (COCUS NUCIFERA LINN.)

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Access this article online: www.jahm.in

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Received on: 10/01/2014, Revised on: 19/01/2014, Accepted on: 19/01/2014

Abstract

Background: Narikela Khanda is a Khanda preparation whose main ingredient is pulp of Narikela Phala. It is mainly indicated in Shula Vikaras and Amlapitta. Narikela Phala is highly nutritious and rich in fiber, vitamins, and minerals. **Aim:** Preparation of Narikela Khanda and Narikela Khanda granules in three batches with strict quality control procedures and to set qualitative and quantitative parameters. **Settings and Design -** The study was carried on two herbal compound formulations of Narikela (Cocus nucifera Linn) i.e. Narikela Khanda and Narikela Khanda granules. Here 3 samples of Narikela Khanda and Narikela Khanda granules were prepared under hygienic conditions. Standardization was maintained in all the three stages i.e. raw drug selection, during process and after process. **Materials and Methods:** Narikela Khanda was prepared as per the classical reference mentioned in Bhaishajya Ratnavali Shularogadhikara and granules were prepared by further heating the same formulation and transforming into granule form. The prepared Narikela Khanda and granules was analyzed to fix the range of standard values. **Results:** pH of the Narikela Khanda was 5.75 ± 0.03 and that of granules was 5.69 ± 0.02 , loss on drying in Khanda was $10 \pm 0.20\%$ w/w and in granules was $8 \pm 0.15\%$ w/w, the ash value in Khanda was 2 ± 0.30 and in granules 3.5 ± 0.20 . **Conclusions:** The study revealed that organoleptic characters, pH and extractive values of both the formulations were in close proximity in all the batches. Conversion of the Narikela Khanda into granules helps to increase the acceptability and the shelf life of the product.

Keywords: Standardization, Standard operating procedure, Khanda, Granules, Shelf life, herbaceutics, Ayurvedic Pharmaceutics

Introduction:

The coconut palm is highly valued as both a source of food and medicine that is why it is called "The Tree of Life." The white, fleshy part of the seed is edible and used fresh or dried in cooking.¹

He is the best physician, who knows the science of administration of drugs with due

reference to climate and season and who applies it only after examining each & every patient individually. The drug, which is not understood perfectly, is comparable to poison, weapons, fire and the thunderbolt, while the perfectly understood drug is comparable to Ambrosia.²

Narikela Khanda is an Ayurvedic preparation which is modified state of Avaleha preparation, which is prepared by using pulp (endosperm) of coconut, coconut water and other ingredients. The same formulation is transformed in to granule form i.e. Narikela Khanda granules by keeping the ingredients same with the view to increase the acceptability and the shelf life.

Narikela Khanda is one of the Khanda Kalpana which is modified state of Avaleha preparation, which is prepared by using pulp (endosperm) of coconut, coconut water and other ingredients. The same formulation was transformed into granule form i.e. Narikela Khanda granules by keeping the ingredients same with the view to increase the acceptability and the shelf life.

Therefore, in this study an attempt has been made to standardize Narikela Khanda and Narikela Khanda granules, based on various analytical parameters and high performance liquid chromatography.

Materials and methods:

Procurement and preparation of drugs:

The crude drugs mentioned in Bhaishajya Ratnavali (Shularogadhikara).³ for the preparation of Narikela Khanda were taken from the pharmacy of IPGT and RA, Gujarat Ayurved University, Jamnagar, after proper authentication by the Department of Pharmacognosy of the Institute. The plant material was cleaned by sorting out using a cloth duster to remove dust and air blowing to remove minute sand particles. Narikela Khanda and Granules was prepared by selecting raw materials of the same sources, by using similar methods in three batches

following strict standard operative procedures. The crude drugs used in Narikela Khanda and granules with their botanical identities and parts used are given in [Table 1].

Preparation of Narikela Khanda:

At first fine powders of crude drugs from 5 to 14 were separately powdered and sieved with mesh no. 80 and kept aside in air tight plastic containers. Coconut was washed with tap water and cleaned with clean cloth. Then coconut was pierced in the eyes of it and water was collected and filtered with plastic sieve in a measuring jar. Then coconut was broken and its pulp was carefully separated with help of a clean knife. The pulp of the coconut was grated with the help of grinder and was collected in a wide mouthed iron pan and fried with ghee, heating was continued till ghee starts to separate from pulp. Previously collected coconut water was filtered and collected in a separate stainless vessel in mentioned quantity, and Khanda Sharkara (sugar candy) was added and kept on Mandagni on a gas stove, maintaining the temperature between 90°C and 95°C for preparing Paka. When Khanda Sharkara completely melts then the contents were filtered in another vessel and kept for further Paka. When the Paka reaches the stage of Paka Siddhi Lakshanas (features of perfection) of three thread consistency, then fried pulp is added and stirred for homogenous mixture. Then the vessel is taken out of fire and fine powders of ingredients 5 up to 14 were added one by one and stirred well to get a homogenous mixture. When it gets completely cooled it is packed in air tight pet bottles. [Table.1].

Table 1: Crude drugs used for preparation of Narikela Khanda and Narikela Khanda granules.

Sl.no	Ingredients	Latin name	Part used	Quantity used		
				Batch – I	Batch – II	Batch – III
1.	Narikela	<i>Cocos nucifera</i> Linn.	Pulp	192g	384g	768g
2.	Goghrita	<i>Clarified butter</i>	--	48g	96g	192g
3.	Khanda Sharkara	<i>Candy sugar</i>	--	192g	384g	768g

4.	Narikela Jala	<i>Cocos nucifera</i> Linn.	Water	768ml	1536ml	3072ml
5.	Dhanyaka	<i>Coriandrum sativam</i> Linn.	Fruit	3g	6g	12g
6.	Pippali	<i>Piper longum</i> Linn.	Fruit	3g	6g	12g
7.	Musta	<i>Cyperus rotundus</i> Linn.	Rhizome	3g	6g	12g
8.	Vamsalochana	<i>Bambusa arundinaceae</i> Willd.	Siliceous concretion	3g	6g	12g
9.	Shweta Jiraka	<i>Cuminum cyminum</i> Linn.	Fruit	3g	6g	12g
10.	Krishna Jiraka	<i>Carum carvi</i> Linn.	Fruit	3g	6g	12g
11.	Twak	<i>Cinnamomum zeylanicum</i> Blume.	Stem bark	3g	6g	12g
12.	Ela	<i>Elettaria cardamomum</i> Maton.	Seeds	3g	6g	12g
13.	Tejapatra	<i>Cinnamomum tamala</i> Ness.	Leaf	3g	6g	12g
14.	Nagakeshara	<i>Mesua ferrea</i> Linn.	Stamen	3g	6g	12g

Preparation of Narikela Khanda granules:

Same procedure was followed as in preparation of Narikela Khanda. But the Paka Siddhi Lakshanas, was of four thread consistency. The Narikela Khanda was passed through mesh no. 10 and granules were prepared and the granules were dried at room temperature. After completely self cooled and dried, it is carefully collected and packed in air tight pet bottles and preserved.

The formulations of Narikela Khanda and Narikela Khanda Granules were analyzed by employing various related analytical parameters, like

A. Organoleptic parameters: Rupa (colour), Rasa (taste), Gandha (odour) and Sparsha (touch).

B. Physico-chemical parameters: pH of 5% Aqueous Soln.⁴, Loss on drying at 110°C⁵, Ash value⁶, Water soluble extractive⁷, Methanol soluble extractive⁸, Hexane soluble extractive⁹, Volatile oil content¹⁰, and Reducing Sugars.¹¹

C. Qualitative tests for various functional groups:^{12,13} Tannins, Sterols/ Terpenoid, Alkaloid, Saponins, Starch, Flavonoids, Glycosides and Carbohydrates

D. Chromatographic Analysis: H.P.L.C.¹⁴

E. Toxicological: Heavy metal analysis¹⁵, Pesticide residue value¹⁶.

F. Microbial Overload¹⁷: Bacterial and fungal growth study was carried out.

Reagents and Chemicals:

All the reagents and chemicals used for the study were of analytical grade and purchased from the authorized dealer.

Observations and Results:

Comparative organoleptic characters, i.e., Rupa (color) were woody brown, Rasa (taste) was Madhura Rasa (sweet taste), Gandha (odor) was aromatic due to the specific properties of the various ingredients and Sparsha (consistency/texture) of Narikela Khanda and granules was solid as given in Table.2. pH of the Khanda was 5.75 ± 0.03 and that of granules was 5.69 ± 0.02, loss on drying in Khanda was 10 ± 0.20% w/w and in

granules was $8 \pm 0.15\%$ w/w, the ash value in Khanda was 2 ± 0.30 and in granules 3.5 ± 0.20 as given in Table.3. Qualitative analysis reveals the presence of tannins, terpenoids,

alkaloids, saponins, starch, flavanoids, carbohydrates in the formulation, whereas glycosides, antraquinine derivative and coumarines were absent as given in Table 4.

Organoleptic character	Khanda	Granules
Rupa (colour)	Woody brown	Woody brown
Rasa (taste)	Sweet	Sweet
Gandha (odor)	Aromatic	Aromatic
Sparsha (consistency)	Solid	Solid/Granules

Parameter	Khanda	Granules
pH at 5% Aqueous Soln.	5.75 ± 0.03 (3)	5.69 ± 0.02 (3)
Loss on drying at 110°C (%w/w)	10 ± 0.20 (3)	8 ± 0.15 (3)
Ash value (total) %w/w	2 ± 0.30 (3)	3.5 ± 0.20 (3)
Volatile oil content (% v/w)	0.2 ± 0.05 (3)	0.2 ± 0.03 (3)
Extractive values (%w/v)		
Water soluble extractive	64 ± 0.2 (3)	72 ± 0.6 (3)
Methanol soluble extractive	41 ± 2.5 (3)	43 ± 0.8 (3)
Hexane soluble extractive	16 ± 0.6 (3)	14 ± 1.5 (3)
Reducing sugars (%)	40 ± 3.5 (3)	43 ± 2.5 (3)
The numbers in parentheses indicate the numbers of samples carried out		

Components	Khanda	Granules
Tannin	+	+
Terpenoid/Sterols	+	+
Alkaloids	+	+
Saponins	+	+
Starch	+	+
Flavonoids	+	+
Carbohydrates	+	+
Antraquinine derivative	-	-
Coumarines	-	-
+ Present, - Absent		

Findings of the analysis of HPLC, heavy metals, pesticide residual value, microbial count and pathogens of Narikela Khanda and granules are shown in Tables 5–11, respectively.

Table 5: Showing the peak area of Narikela Khanda in HPLC at wave length 270 nm.

Name	Rt	Area	Quantity
Component 1	1.77	9479.000	0.000
Component 2	2.17	42335.500	0.000

Rt = Retention time, Total Area of peak = 51814.50

Table 6: Showing the peak area of Narikela Khanda granules in HPLC at wave length 270 nm.

Name	Rt	Area	Quantity
Component 1	1.78	10006.500	0.000
Component 2	2.13	15601.500	0.000
Component 3	2.47	4765.000	0.000

Rt = Retention time, Total Area of peak = 30373.00

Table 7: Showing the peak area of Narikela Khanda in HPLC at wave length 200 nm.

Name	Rt	Area	Quantity
Component 1	2.13	440294.250	0.000
Component 2	2.69	29331.500	0.000
Component 3	3.35	164326.250	0.000

Rt = Retention time, Total Area of peak = 633952.00

Table 8: Showing the peak area of Narikela Khanda granules in HPLC at wave length 200 nm.

Name	Rt	Area	Quantity
Component 1	2.08	367309.750	0.000
Component 2	2.66	13784.500	0.000
Component 3	3.34	110840.000	0.000

Rt = Retention time, Total Area of peak = 491934.25

Table 9: Showing heavy metal analysis of Narikela Khanda and Narikela Khanda granules.

Heavy Metal	Wave length	Limit	Khanda mg/kg (ppm)	Granules mg/kg (ppm)
Arsenic (As)	193.696	3 ppm	Not Detected	Not Detected
Lead (Pb)	220.353	10 ppm	Not Detected	Not Detected
Mercury (Hg)	253.652	1 ppm	Not Detected	Not Detected

Cadmium (Cd)	228.802	0.3 ppm	Not Detected	Not Detected
Table 10: Pesticide residual value of Narikela Khanda and Narikela Khanda granules.				
Organophosphorous Pesticide	Limit (mg/kg)	Khanda % Area	Granules % Area	
Dichlorovos	1.0	Not Detected	Not Detected	
Diazinon	0.5	Not Detected	Not Detected	
Methyl Parathion	0.2	Not Detected	Not Detected	
Parathion	0.5	Not Detected	Not Detected	
Phorate	0.05	Not Detected	Not Detected	
Phorate Sulfoxide	0.05	Not Detected	Not Detected	
Azinphos-methyl	0.0025	Not Detected	Not Detected	

Table 11: Total microbial count and pathogens of Narikela Khanda and Narikela Khanda granules.			
Test parameters	Limit	Khanda	Granules
Total Microbial Count	100 CFU per g	50 CFU per g	80 CFU per g
Total bacterial count		50 CFU per g	60 CFU per g
Total fungal count		00 CFU per g	20 CFU per g
Pathogens			
E. Coli	Should be absent per 10 g	Absent	Absent
Salmonella spp.		Absent	Absent
Pseudomonas aeruginosa		Absent	Absent
S. aureus		Absent	Absent

Discussion:

Khanda Kalpana is one of the important Upakalpana which is highly palatable and having nutritional value. It is considered as a variant of Avaleha Kalpana. The preparation like Khanda Kalpana apart from the palatability have others beneficial aspects¹⁸. These preparations have comparatively longer shelf life mainly due to less moisture, presence of sugar and ghee¹⁹.

Unit process of Narikela Khanda and Narikela Khanda granules, included the preparing of Kalka by the Narikela Phala Majja, followed by frying it with ghee on Mandagni until the Kalka becomes slight brown colour and ghee

starts to separate from Kalka. Average yield of Kalka after frying with ghee in both the formulations was found to be 50% w/w. This indicates the complete evaporation of moisture from the Kalka, which helps in stabilizing the formulation. During frying of the Kalka the temperature was maintained in an average between 65 to 70⁰C, which allows the slow contact of drug with fat in mild fire, due to which the active components are not evaporated, only moisture is evaporated.

Sugar candy was added in Narikela Jala and Paka was prepared by maintaining the sugar solution in boiling state, this leads to process of inversion i.e. formation of glucose and

fructose from sucrose. Slow heating results in excess acid hydrolysis and may produce to soften the product. Application of heat imparts kinetic movement to the sugar molecules, where as when it is cooled loss of kinetic movement makes the sugar molecules to coalesce. This explains the reasoning behind thickening of sugar solution on cooling.

When the Paka reaches the stage of Siddhi Lakshanas i.e. three thread consistency (Tantumam), which indicates the presence of 65-70% of sugar, the Kalka was added and stirred for homogenous mixture. In Narikela Khanda granules the stage of Siddhi Lakshanas is four thread consistency, which indicates the presence of 70-75% of sugar. This depicts the less moisture content in the granules compared to Khanda. This also increases the concentration of sugar in granules compared to Khanda.

Average time required for preparation of Narikela Khanda was 3 hr 56 min, while average time required for preparing Narikela Khanda granules was 4 hr 10 min. Average 20 to 30 minutes more time was required for the preparation of granules. Where it is heated further and the granules are further dried.

The organoleptic parameters form the basic criteria for selecting a raw drug and also to confirm the finished product. All the three batches had similar desirable organoleptic features. The samples were of woody brown color with solid consistency hence that they can be cut into pieces, they were aromatic with sweet taste. These preliminary findings indicate that in all three batches the products full fills the basic standards of Khanda Kalpana. [Table 2]

The pH conventionally represents the acidity or alkalinity. The pH of Narikela Khanda was 5.75 while that of the granules was 5.69, both are weak acidic in nature.

Ash value depends upon the total inorganic substances present in the particular drug, this parameter has importance in quality control and standardization of drugs. More the inorganic substances present in drugs higher will be the ash value. Here ash value of all the raw drugs was within the limit mentioned in

A.P.I. (Ayurvedic Pharmacopoeia of India). The ash value of granules was 3.5%w/w bit more compared to Khanda 2.0%w/w, this may be due to more heating process involved in preparation of granules.

Loss on drying indicates the moisture content; in the present study it was 10% in Narikela Khanda and 8% in Narikela Khanda granules. This indicates that moisture content of granules is less compared to Khanda. This is indicative of chances for more shelf life of granules than Khanda.

Various components have their solubility in particular media. Here soluble principles of the samples were seen in water, hexane and methanol. Hexane and methanol soluble extractive of both the formulations were nearly same with less difference, but there was increase of water soluble extractive in granules, which depicts more bio availability of granules than Khanda.

Volatile oil protects the formulations from the attacks of the insects, depicts the presence of alkaloids, colouring matter, tannin and nutritional value. Volatile oils in both the formulations were same i.e. 0.2%.

Qualitative tests are used to detect the presence of functional groups, which plays very important role in the expression of biological activity. Present study reveals the presence of tannin, sterols, alkaloid, saponins, starch, flavanoids and carbohydrates in both the formulations, and absence of glycoside, antraquinone and coumarines was seen in both the formulations.

H.P.L.C. is the most versatile, safest, dependable, fastest and sensitive chromatographic technique for the quality control of drug component. Qualities and quantitative analysis of drug material was done by this method. Similar components were detected in both the formulations at 270nm and 200nm. But there was decrease in the peak area of Narikela Khanda granules, this may be due to more contents of sugar in granules than Khanda. The granule formulation retained the components of Khanda, there is no loss of component in granules. (Figure 1 and 2).

Figure 1: HPLC of Narikela Khanda and Narikela Khanda granules at wave length 270 nm.

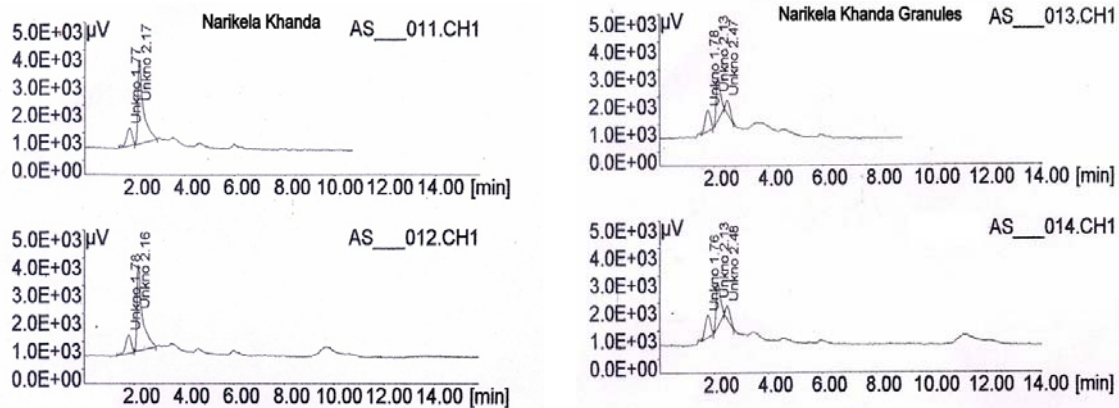
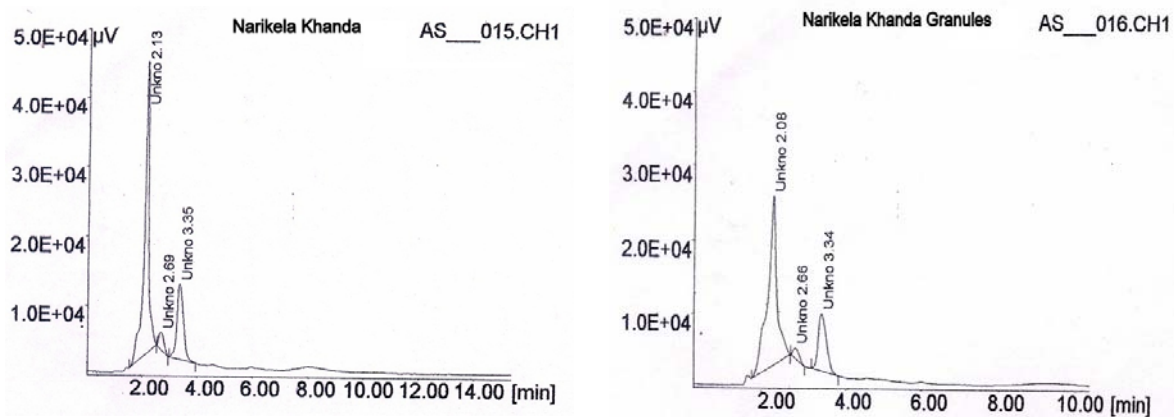


Figure 2: HPLC of Narikela Khanda and Narikela Khanda granules at wave length 200 nm.



Heavy metals were not detected [Table 9], thus showing the purity of the raw drugs and also the finished product. This also indicates quality control maintenance during pharmaceutical preparation. Medicinal plant materials are liable to be affected by pesticide residues which accumulate from agricultural practices of spraying, treating soils during cultivation and through the administration of fumigants during storage.

Organophosphorous pesticides were found below the detection limit, which is a clear

indication of quality land practices and safe storage of raw drugs [Table 10].

Medicinal plant matters normally carry bacteria and moulds often originating in soil in high numbers. In the present formulation, the microbial count was within permissible limits²⁰, which indicates the proper hygiene norms followed during the preparation of formulation and packing. [Table 11]

Conclusion:

Avaleha and Khanda are palatable dosage forms which have high nutritional value, along with its therapeutical value. Converting Khanda in to granule form helps in fixing the

dose, easy administration and also increases the shelf life of the formulation. The adopted manufacturing procedure can be accepted as S.M.P. (Standard Manufacturing Procedure)

for Narikela Khanda and Narikela Khanda granules. The present analytical parameters can be used for routine quality control of the formulations.

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Cite this article as: Baragi Pramod C, Baragi Jyoti P, Baragi Umapati C, Patgiri B.J, Prajapati P.K. Standardization of Narikela Khanda and Narikela Khanda Granules - Herbal Compound Formulations Of Narikela (Cocos Nucifera Linn.). Journal of Ayurveda and Holistic Medicine (JAHM). 2014; 2(1).p.1-9.

Source of support: Nil, Conflict of interest: None Declared.