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The Rationality of Dhupana Karma (Fumigation) as a Protective Measure for Neonatal Care in Kumaragara (Infant's Abode and NICU)

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ABSTRACT:
After birth, a baby gets exposed to the external environment, having billions of microorganisms, but all the microbes are not harmful as most of them are commensal. However, some of them became hazardous, particularly in immunocompromised infants. So, environmental sterilization is of utmost priority for inhibiting the growth of microbes in the *Kumaragara* (Infant's Abode and NICU). In *Ayurveda*, *Raksha karma* (protective measures) is indicated for wound healing (*Vrana Upakrama),* as well as neonatal care (*Navajaata Sishu Paricharya).* Newborn care through the *Dhoopan Karma is* considered a disinfectant to prevent and cure infectious diseases.
With a dynamic variation in microbial flora and emerging resistance, fumigation of *Kumaragara* with *Ayurvedi*c drugs as a sterilization procedure is needed, compared to formaldehyde fumigation commonly used in hospital setups because of serious adverse effects on the human body.
However, some research has shown antimicrobial properties of bioactive substances of *Dhoopan* drugs as well as their formulations, but due to lack of scientific validation and standardization of *Dhoopan* drugs, drug dosages and dispensing form of fumigating drugs, and *Dhoopan karma vidhi* (methodology*)* as a sterilization measure is yet not established.
The present paper details the pros and cons of *Dhoopan karma*

Keywords: Raksha Karma, Dhoopan, Sterilization, Herbal-formulations.

INTRODUCTION:

Navajaata shishu paricharya is an essential part of neonatal care in *Ayurveda* after establishing all vitals in a newborn baby, starting from *Pran pratyagamana to Rakshakarma* for newborns.
Our utmost priority is to maintain asepsis, which comes under the general care of the newborn baby right from the very beginning of the life of a child. As a protective measure, *Rakshakarma* has already been mentioned in ancient literature. Still, some of its parts, such as *Dhoopan karma,* a significant way to achieve protection from microbes, arthropods, etc., is traditionally practiced among peoples of remote area and villages. The current concept of protection from diseases caused by microbes in newborns at birth is focussed. It includes a clean umbilical cord, hands, clean surface, sterile instruments, etc., the basis for neonatal resuscitation. That is very useful in preventing neonatal septicemia and improving newborns'

quality of life.

Raksha karma (~protective care) is mentioned and elaborated in our classical *Ayurvedic* texts (*Vrihattrayi)* scattered, basically with two primary purposes - prevention from onset and cure of neonatal diseases. Apart from *Vrana upakrama* (wound care), *Rakshoghna karma* has been emphasized in *Navajaata Sishu Paricharya* (Immediate care of the newborn).

Raksha and its various derived words are used predominantly in the *Vedic* literature to protect, guard, take care of, govern, keep, preserve, save, avoid, observe, and beware of evil spirits or demons.[1] *Raksha karma* (~Protective measures), a significant practice employed in *Ayurveda*. It effectively shields the infant through the physical and psychological barrier. Under this process, several medications are used to fumigate the *Sutikagara/Kumaragara* to prevent opportunistic infections and safeguard the infant.

According to WHO, 50-60% of all neonatal deaths occur within the first month of life due to poor aseptic technique practices in the labor room; of these, more than half may die during the first week of life. Recent studies on various herbal drugs mentioned in *Dhupana karma,* including their bioactive compounds, have experimentally shown antimicrobial activity and aseptic properties.

Therefore, the present review article will explore *Rakshoghna* drugs and their bioactive compounds having antimicrobial properties. A comparison and discussion of antique and currently used protective drugs/formulations, methodologies, dosages, and dispensing forms for getting ideal formulation and microbe's specific *Rakshoghna* drugs/formulation for the NICU, PICU, or Paediatric wards have been made.

MATERIAL AND METHODS

To collect the data specific to *Rakshakarma dravya* () with their properties, Bioactive substances of herbal drugs, methodologies including methods of drug preparation, dispensing form, drug dosages, antimicrobial properties, etc., were reviewed from different research/review articles, classical textbooks by searching PubMed, Scopus, AYUSH research portals, etc.

Charaka Samhita thoroughly explains *Raksha Karama*—the protection of the newborn under the heading of antisepsis of clothes, bedding, etc., and aseptic methods to avoid environmental illnesses. Around the *Sutikagara* (the location of the mother after giving birth), the branches of *Adani, Khadira, Karakndu, Pilu, and Parushaka,Srshapa* (yellow mustard), *Atasi, and Tandulakan-kanika* (rice particles) should be hung. *Sarshapa, Atasi,* etc should be dispersed over its floor. You should do "*Tandul Bali Homa*" twice daily, in the morning and evening. At the entrance near the door, the *musal* (pestle) should be positioned obliquely. The fire always be lit by inserting *Tinduka and kana-kantak (Ingudi*) wood in the *Sutikagara. Vacha, Kustha, Kshomka, Hingu, Sarshapa, Atasi, Lasuna, Guggulu,* and other *Rraksoghana dravyas* should be placed in a packet and put on the door, with similar *dravyas* being tied around the necks of the mother and child. Well-wisher, skilled ladies are kept alert and vigilant in *the Sutikagara* throughout the first 10 to 12 days, i.e., Baby shouldn't be left unattended. *Sutikagara* should be filled with presents and lucky things. Recitations, blessings, music, and instrument playing, along with committed, loyal, and happy people. The individual with knowledge of *Atharvaveda* carries out *Homa or Shanti-Patha* [the ritual of offering sacrifices in the fire] to shake mother and baby's wellness in the morning and evening.[2]

Sushruta Samhita:- The newborn was instructed *by Acharya Sushruta* to be wrapped in *kshauma* (linen) cloth and placed on a bed covered with soft linen. Use twigs from *pilu-badar-nimba-parushaka* to gently fan the infant. Apply a cotton tampon (*Taila pichu*) that has been impregnated with oil over the infant's head every day. *Rakshoghana dravyas* should be used for fumigation in the *Sutikagara.* The hands, feet,

head, and neck should all have these *Rakshoghana* medications wrapped over them. *Tila, Atasi, Sarshapa, and kana* (rice particles) are dispersed throughout *the Sutikagara.* The area needs to have a firelighter. One should adhere to the *Vranitopasniya* context (management of wounded individuals).

Sushruta uses sixty ways to manage wounds (*Sasthi upakrama*). One of them is *Raksha karma or Rakshavidhan.* The wound should be fumigated by pain-relieving and *Rakshoghana* fumes, and protection is ensured by reciting hymns. Once more, *Sushruta* advises that the wound be fumigated using a combination of powdered *Guggulu, Nimba* tree leaves, *Agaru, Sarjarasa, Vacha, Sarshapa, Saindhava, and Gh*rita. The remainder of the *Ghrita* was then applied to the heart region and other vital areas*(marma*) of the patients. Afterwards, protective hymns should be recited to counteract the dread of evil spirits *(Raksasa*), serpent demons *(Naga),* devils (*Pishacha)*, spirits (*Yaksha)*, evil spirits *(Nishachara*), etc.[3]

Acharya Vagbhata described similar *Raksha karma* as described by *Charak*a; *Vagbhata* also mentioned the use of herbs such *as Brahmi, Indryana, Jivaka,* and *Rishbhak*a to be tied around the hands or neck of the neonates. *Vagbhata* also mentions the use of *balvach*a, which promotes *medha (* intelligence), *smriti*(memory*), swasthya*(health) and *ayu(*longevity) of the baby.[4]

Astanga samgraha:- Tie a cotton pouch containing *Hingu, Vacha, Turuska, and Sarshapa* on the upper frame of the door and head side of the bed (cradle) and also in the neck of the infant and mother.

Further, there is mention *of Dhupana for* baby's abode consisting of containing *dried crow feathers along with trivrt,vacha,kustha,sarshapa and little ghrta.*Additionally, *Acharaya Vagbhata* suggested taking precautions on the sixth night after giving birth *(SasthiRatri*). All family members and friends should stay up on the sixth night after the baby is delivered. Ancient Scholars have noted and meticulously monitored the most important period as prone for infection i.e early neonatal period which includes birth upto six days. Care of the sixth night means that early neonatal, or from birth through the first week. After one week, the incidence of infections and complication reduce, therefore the chances of survival increase.[5]

According to ***Arogyakalpdruma*****,** *Kumaragara* should be fumigated. The horns, hooves of *Krishna, Saralu, Laya,* Avi- Dears and *Gandhaka* along with *Gojihva and Sweta Sharshapa* (white mustard) are taken in equal amount, powdered and mixed with butter and heated. The fumes generated (*Dhupana*) helps to protect the child.[6]

***Kashyap Samhita* :-** Ancient scholars have mentioned *Dhupana* in scattered manner but *Kashyap acharya* has given the utmost importance to it and created a separate chapter named *Dhupa kalpadhyaya* . In which, (Fumigatory preparations) has been listed with its specific effect. There are many preventive methods, mentioned in *Ayurveda* like *sadvritta* (Ideal regimen),*rtucharya* (Seasonal regimen), *rasayan* (Rejuvenation)and *Dhoopan* etc . Out of all above,*Dhoopan* should be specially carried out by healthcare worker to prevent nosocomial diseases to society. As per *kashyap acharya*, fumigations are illustrated to give success to physician, progeny to human beings and to cure all diseases.

There are three types of fumigations, on the basis of action, i.e.*dhupa* (Fumigation),*anudhupa* (Subsequent Fumigation) and *pratidhupa* (Antifumigation) . Strong fumigation is advocated in some disease condition called as *dhupa.* Such strong fumigation may cause side effects, so it should be followed by subsequent fumigation known as *anudhupa* and if any side effect occurs, to counteract Antifumigation or *pratidhupa* should be performed.[7]

Atharvaveda	*Guggula, Ajashringi for Kriminashana*
Charaka samhita	*Vacha, Kushtha, Kshomka, Hingu, Sarshapa, Atasi, Lasuna, Guggulu, and other Raksoghana Dravyas. Krimighana Mahakasaya(Guduchi,*

	Karkatshringi, Hingu, Inguli, Kantakari, Twak, Nimba, Patol, Apamarga, Guggula.
sushruta samhita	*Rakshoghna Gana - Guggul , Agaru, Sarjrasa, Vacha, Gaura Sarshapa, Lavana, Nimba-patra, Ghruta*
Kashyapa samhita	*Rakshoghna Drvays - Ghrita, Hingu, Akshata, Skin of Reptile (Snake), Siddhartak (Brassica alba), Dev Nirmalya (flowers of herbs offered to god), Akshata (unbroken rice), Sarpa-tvak (shed skin snake)*
Astanga hrdaya	Same as in *Charaka* and *Brahmi, Indryana, Jivaka* and *Rishbhak*a.
Astanga sangraha	*Hingu, Vacha, Turuska and Sarshapa,* containing *dried crow feathers along with Trivrta, Vacha, Kushtha, Sarshapa and little Ghrta*

RESEARCH ARTICLES

Various antimicrobial studies have been done to prove the efficacy of *Dhoopan* drugs for bactericidal, bacteriostatic, antifungal etc study. Moreover *Ayurvedic* pharmacodynamics of these *Dhoopan* drugs are also very significant to analyse the mode of action.

In view of neonatal abode / NICU (*Kumaragara) Dhoopan* in terms of sterilization, first of all we have to decide about how to collect samples from NICU from air as well as surface/floor as there is dynamic variation of concentration and type of microorganism present in each specific area of environment.

Air Sampling:-

A. ***Passive Method*:** Sample collected from air of NICU environment to evaluate microbial load, is done by **exposure agar plate.** The method opted is **settled air sampling method, (passive air sampling).** Nutrient agar medium enriched Petri dish (**blood agar/tryptic soya agar/ Luria Bertani [L.B.] medium)** for bacteria and **malt extract agar/potato dextrose agar** for fungi) are exposed to open air of NICU at the desired locations. after certain period of time, plates are collected by aseptic method and sent to lab for microbiological study (colony count/cfu) within 24 hrs of collection, where incubation should be done for at least 24 hrs. Two samples are taken to assess pre and post fumigation by traditional and aerosol method in total colony count of microbes present in air and 1 sample for control group by formaldehyde fumigation.

B. ***Active Method*:** active air sampling can also be done which is collected by automated air sampler, which is value of cost.

Environmental Surface Sampling:-

Surface sampling is used to collect viable as well as non-viable microorganisms from the surface. Viable refers to living microorganisms. An easy way to determine the presence of mold on a surface is to sample the surface using adhesive tape. The commonly used methods are the **swab method** and the **Gauze pad method.**

A. ***Swab method*** : Each site is sampled using a sterile cotton swab pre-moistened with 0.9% NaCl for injection. The swab is rolled back and forth over each surface three times to ensure that all sides of the swab made contact with the surface and that maximal surface area is covered. Neutralizing buffer solution must be used to keep the sample patent for longer duration

B. ***Gauze pad method*:** A sterile 7.5 X 7.5 cm gauze pad is moistened with Mueller-Hinton broth and rubbed against the surface in the same manner as the swab .

By these methods, samples are collected from neonatal skin surface also to assess antimicrobial efficacy and skin flora.

NICU Flora And Skin Microbiota In Neonates:-

There are various microorganisms of which majority are commensal of human body, which we called as microbiome/ good bacteria. The vision of seeing the microbes has now changed.in fact imbalance in commensals lead to disease states, which we mostly found in NICU environmental surface. There are difference of microbiomes in terms of proportion in skin microbiome acc.to age.as in infant skin, firmicutes [staphylococcus, streptococcus, proprionbacter**]** shows predominance**.** microbiomes provide innate immunity to newborn as there is symbiosis between skin and skin flora. antimicrobial defense system in skin is not just a mechanical barrier. Ultimately it signals to brain-gut microbiota axis, which regulates stress responses and develops cognition as well as behavioural changes. otherwise it will lead to develop autism, ADHD, depression ,anxiety in children. Various factors which leads to early colonization of microbiome: vaginal delivery, breast feeding, skin to skin contact of mother[KMC].as studies found that there is relation between caesarean section with disturbed intestinal colonization (pathogenic organisms), NEC, celiac disease etc.[15-19]

In vitro antimicrobial evaluation of various *Dhoopan* formulations:-

Various experimental studies showed the potent antimicrobial efficacy of Dhoopan drugs by MIC [minimum inhibitory concentration],CFU[colony forming unit] etc,which is mentioned=

Pros and cons in preparing Dhoopan formulation:-

PROS	**CONS**
Easy availability of raw drugs Easy to prepare dosage forms like *Churna*, *Kalka*, and Varti Cost effectiveness Non carcinogenic effect at certain concentration Non-irritant in comparison to formaldehyde Less toxicity	. Organoleptic parameter= colour and odour . Physiochemical parameter=loss on drying, total ash value [acid soluble and insoluble], alcohol and water soluble extracts, p^h etc. (these analysis for standard fumigation guideline is still obscured) . Comparative efficacy of raw drug fumigation and fumigation through aerosol method by extracts.

Pros and cons in *Dhoopan* procedure for sterilization purpose:-

pros	**cons**
Rakshoghna purpose Anti-microbial efficacy experimentally proved Dhoopan activates CNS drug delivery system via intranasal route. Related to brain gut axis	There is no any standard of proper dosage of fumigating drugs . No specific duration of fumigation is available

OBSERVATION AND ANALYSIS

1. **phytochemical study:** various experimental study has been done to achieve active ingredient and chemical constituents of *Dhoopan* drugs by-

HPTLC [high profile thin layer chromatography], **HRLCMS** [high resolution liquid chromatography mass spectrometry], **GCMS** [gas chromatography mass spectrometry], **SEM** [scanning electron microscope], **XRD** [x ray diffraction analysis] etc.

2. antimicrobial study: this is experimentally proven that *Dhoopan* has significant role in decreasing microbial load.

Ayurvedic* pharmacodynamics of commonly used *Dhoopan dravyas (Sumitha and Prasad, IJPSR, 2015; Vol. 6(7): 2950-2954)[8]

Dravya	***Rasa***	***Guna***	***Virya***	***Vipaka***	***Karma***
Guggulu	*Katu, Tikta*	*Ruksha, Laghu*	*Ushna*	*Katu*	*Kusthaghna, Rasayan, Lekhan*
Vacha	*Tikta, Katu*	*Tikshna, Laghu*	*Ushna*	*Katu*	*Krimighna*
Sarjarasa	*Madhur, Kashaya*	*Ushna, Ruksha*	*Sita*	*Katu*	*Kandughna, Krmighna*
Nimba	*Tikta, Kashaya*	*Ruksha, Laghu*	*Sita*	*Katu*	*Krimighna, Kusthaghna*
Ushira	*Madhur, Tikta*	*Ruksha, Laghu*	*Sita*	*Katu*	*Kushthaghna*
Devdaru	*Kashay, Tikta*	*Ruksha, Laghu*	*Ushna*	*Katu*	*Krmighna, Kandughna*

Antimicrobial studies of various *Dhoopan* drugs (Sabu Indu et.al.,: Potentials of Ayurveda fumigation formulations) **:-**

Drug	**Latin Name**	**Research Activity**
Kushtha	*Saussurea lappa*	It has antiviral potency against Hepatitis B virus for a treatment duration of 12 weeks[9]
Nimba	*Azadirachta indica*	Neem fumes against *Streptococcus pyogenes* after 10- minute exposure showed 100% inhibition and 50% inhibition after 5-minute exposure, it also showed inhibition of *Staphylococcus aureus, Staphylococcus epidermidis,* and *Pseudomonas aeruginosa* under same study setting.[10] Neem leaf extract inhibits the growth of Dengue virus, type 2, a viral haemorrhagic fever related to Ebola virus
Guggulu	*Commifora mukul*	Ellagic acid has also antiviral and antibacterial Efficacy of *Dhupana* recipe containing *Guggul, Aguru, Sarjarasa and Sarshapa* added *with Lavana, Nimba patra & Ghee* was used for O.T. fumigation. The swab reports of O.T. were like modern technique of formalin fumigation & gave significant results[11]
Sarjarasa	*Shorea robusta*	Found the presence of very high concentration of bioactive components such as alkaloids, glycosides, phenols, tannin, steroids and terpenoids which has high antibacterial activities[12].
Aguru	*Aquillaria agalocha*	roots have higher antimicrobial activity against *Klebsiella pneumonia*. Dry powder of leaf and bark of *Aguru* shows activity against pathogenic bacteria such as *Shigella flexneri*, bacillus brevis, yeast, dermatophytes and helminths.[13]

Devdaru	*Cedrus deodaru*	Essential oils and ethanol extracts derived from cones, leaves and wood ,shows antiviral activity against Herpes simplex virus[HSV] type-I.[14]

3. clinical study: this is the need of hour now.so we will be able to frame *Dhoopan* as an alternative sterilization purpose.

Phytochemical and antimicrobial study of *Dhoopan* drugs: various experimental studies showed the potent antimicrobial efficacy of Dhoopan drugs by MIC [minimum inhibitory concentration],CFU[colony forming unit] etc,which is mentioned=

***AGURU*:-**According to Satapathy et al. (2009),[20] the heartwood of Agaru is abundant in flavonoids (aquisiflavoside, aquilarisinin, aquilarisin, and aquilarixanthone), tannins, essential oils, resins, alkaloids (liriodenine), saponins, steroids, terpenoids, and tannins. Sesquiterpenes and 2-(2-phenylethyl)-4H-chromen-4-one derivatives are the main compounds found in agaru wood. Aquilarone A-I, aquiseninone A-D, tetrahydrochromone A-M, quinanone A-D, 6-methoxy-2-(2-phenylethyl)chromones, 7,8-dimethoxy-2-[2- (3′-acetoxyphenyl)ethyl]chromones, and 6,7-dimethoxy-2-(2-phenylethyl) chromones are among the derivatives of chromones. Agarol, aquilochin, α & β agarofuran, norketoagarofuran, agarspirol, 10-epi-g eudesmol, jinkoeremol, jinkohol, kusunol, dihydrokaranone, oxoagarospirol, qinanol A-F, aquilarabietic acid A-K, aquilarin B, aquilacallane A-B, aquimavitalin, abietane ester, gmelofuran apigenin, and 4′,7-dimethyl ether are examples of sesquiterpenes (Wang et al 2018; Srivastava et al 2016).[21,22] The chemical composition of agaru oil includes tetradecanoic acid, valerianol, dihydrokaranone, vetispira-2(11), agarol, and dihydroselinene (Naf et al 1992, 1995).[23]

Zone of inhibition:-

strain	Methanol soluble leaf extract	Methanol soluble bark extract	aqous leaf extract	Aqous bark extract	gentamycin
Staph.fleximenia	-	-	18	15	23
Bacillus brevis	-	-	-	-	22
pseudomonas aeroginosa	-	-	15	14	-
Bacillus subtilis	19	-	-	15	19

***JATAMANSI*:-** Sesquiterpenes, coumarins, iridoids, and organoids are the primary active ingredients of *V. jatamansi*. Sesquiterpenes include valerenic acid, while other derivatives include valeranone and valve-like. Additionally, lignans 8'-hydro-xypinoresinol and pinoresinol-4-o-dglucoside are examples of organoids. Erioids comprise valepotriates, such as acevaltrate, didrovaltrate, and hydroxyvalerate (isovaleryl). Among the alkaloids are chatinine, morpholine, thaliperphine, nantenine, nordelporphine, phoebine, dehydroaphine, valerine, valeriane, phenanthrene, oxoaporphine as well. Valeriana flavonoids mostly consist of Hesperidin, methyl apigenin, diosmetin, and acacetin kaempferol, luteolin, quercetin, linarin, and luteolin. The. Additional ingredients include sugar, bitter, volatile and essential oils. starch, gum, resin, extractive materials, and ketones (Yang, et al. Patan et al., 2018; al., 2011) [24,25]

The antibacterial activity of V. jatamansi rhizomes was investigated using methanol and distilled water extracts. The extended range B-lactamase that Escherichia coli produces coli, Klebsiella pneumoniae, and Enterobacter aerogenes. The inhibition with pure water and methanol was substantial. extract and is safe to take in addition to other antibiotics. The. Methanol and V. jatamansi distilled water extracts were

assessed for their ability to combat strains of bacteria E. coli with pseudomonas aeruginosa. Of them, the hydroalcoholic extracts at 0.3–0.7 mg/ml concentrations shown enhanced antibacterial efficacy against P. aeruginosa and S. aureus by employing Soybean Casein Digest Agar in a cup plate technique. medium, and the common antibiotic employed was chloramphenicol at 1 mg/ml (Habeeb, et al., 2016).[26]

***GUGGULU*:-** It was discovered that C mukul's volatile oil was very efficient against Rhyzopertha dominica, indicating that it may have a fumigant function. The extract of ethanolic extract shows bactericidal activity of *C. mukul* was highest at 5 mg/mL against Klebsiella pneumonia that is multidrug resistant].[27] 5(1-methyl,1-aminoethyl)-5-methyl is an active chemical-2-Octanone, found in the guggulu gum's methanolic extract, had strong antibacterial action against Gram-positive microorganisms and mildly active against bacteria that are Gram-negative [28,29,30]

Pure guggul extract Tested against bacterial strains in diameter of the zone of inhibition , the negative control was ciprofloxacin. extracts of pure Guggulu to combat Klebsiella pneumonia, Proteus vulgaris, and Pseudomonas aeruginosa. Comparing the pure Guggulu extract with conventional Ciprofloxacin, the result shows substantial antibacterial action against Pseudomonas aeruginosa and Proteus vulgaris.Numerous studies have demonstrated guggulu's antimicrobial properties without the need for purification. It has been determined that guggulu extract has a modest level of action against Klebsiella pneumonia. Against Pseudomonas aeruginosa, raw guggulu showed very little action (4 mm for 10 mg/ml of *Guggul* extract).[31] However, pure Guggul showed considerable effectiveness against Pseudomonas aeruginosa in the current investigation, along with an enhanced zone of inhibition. There have been no research done to assess guggul's effectiveness against Proteus vulgaris. but study shows maximum zone of inhibition against proteus vulgaris. Already The antibacterial properties of raw guggul against Klebsiella Pneumonia had previously been proven.[31] However, the extract of Guggul in its pure form is resistant to Klebsiella and so forth.. Guggul sterones E and Z have been shown to have antimicrobial activity in addition to its other pharmacological activities, which include antioxidant, anti-inflammatory, anti-arthritic, hypolipidemic, wound-healing, cardioprotective, and thyroid-stimulating properties. constituted Despite a little lower amount of Total The Guggul sterones (E+Z) found in pure Guggul serve as the enhanced antibacterial activity may result from the existence of active phytoconstituents such as phenols, flavonoids, and alkaloids steroids, tannins, total sugars, sugar reduction, and furthermore because to a pH of acid.[32]

Diameter of Zone of Inhibition:

Organism	Purified Guggulu [1mg/ml]	Ciprofloxacin [5mg/ml]
P. aeruginosa	15	14
Proteus vulgaris	18	20
K. Pneumonia	0	19

***VACHA*:-** Strong antimicrobial (antifungal and antiyeast) characteristics of the crude methanol extracts of A. calamus rhizome have been found in a recent research by Phongpaichit et al. (2005).[33] They discovered in their research that methanol extract of The rhizome had significant efficacy against filamentous fungus. IC50 values for Trichophyton rubrum, Microsporum gypseum, and Penicillium marneffei are 0.2, 0.2, and 0.4 mg/ml, respectively. correspondingly. But it indicated a modest amount of action against yeasts with modest activity: Saccharomyces cerevisiae, Cryptococcus neoformans, and Candida albicans (MIC 0.1–1 mg/ml), against bacterias (MIC 5–10 mg/ml). Extracts of A. calamus rhizomes obtained with

dichloromethane and ethanol (Mungkornasawakul 2000; Thirach et al. 2003) [34,35] has been reported to exhibit substantial antifungal activity. The ethanol extract of A. calamus inhibited clinical isolates of C. albicans. It is well established that the A- and B-asarones found in leaves, roots and rhizomes are responsible for almost all of the antimicrobial activities of the A. calamus (MacGaw et al. 2002).[36] Leet et al. (2007)[37] have recently investigated fungicidal property of A. gramineus rhizome (methanol extract) against phytopathogenic fungi apart from human pathogenic bacterias. They attributed these antifungal activities to the A-asarone and asaronaldehyde present in A. gramineus.

organism	Zone of inhibition[rhizome]	Zone of inhibition [streptomycin]	Minimum inhibitory concentration[rhizome]
E.coli	20	21	16
Aspergilus niger	25	21	2
Candida albicans	25	22	4
cryptococcus	22	18	5

***DEVDARU*:-**The potential antibacterial and antifungal activity of the separated flavonoidal fractions (F1 and F2) OF *P. longifolia* was evaluated against *Escherichia coli, Bacillus subtilis*, and *Bacillus thuringiensis. coli, Candida albicans, Pseudomonas aeruginosa*, and *Aspergillus niger* correspondingly. The standard was used to conduct the exam. the agar cup-plate technique.[38,39] There are three The potential antibacterial and antifungal activity of the separated flavonoidal fractions (F1 and F2) was evaluated against Escherichia coli, Bacillus subtilis, and Bacillus thuringiensis.

3. **clinical study:** this is the need of hour now.so we will be able to frame *Dhoopan* as an alternative sterilization purpose.

DISCUSSION:

- The method of drug delivery by inhalation has various benefits, such as easier drug administration, increased bioavailability, and a high potential to cross the blood-brain barrier, is ayurvedic fumigation. Typically, *the Dhoopan* formulations are made up of a combination of medications that work in concert to enhance the effects of the primary antimicrobial agent. For this *Dhoopan Karma, Agni and Vayu Mahabhoot Pradhan Dravyas* are generally utilised. These properties of *Dravyas* aid in its quicker combustion and spreadability. Their volatility would be a clear benefit in reducing airborne as well as surface level microbial contamination.[40]
- As can be seen from the preceding description*, Ayurvedic acharyas* have recommended precautions against numerous illnesses for the newborn infant, such as using clean bedding and clothes, in relation *to Rakshakarma .charaka* and *vagbhata* almost described the similar drugs for fumigation.whereas *sushruta* emphasized on *Sasthi upakrama of vrana paricharya.astanga samgraha* mentioned about precautions of *Sasthi ratr*i *.kashyap* vividly described *dhoopa kalpa* where 40 different types of combinations have been explained. *The Sutikagara* (sanatorium/labour chamber) is fumigated (*dhupana*) with several medications to protect the infant from opportunistic illnesses. Several investigations have empirically demonstrated the antibacterial and antimicrobial capabilities of the medications described *in dhupana karma*. According to old texts, the chamber should have illumination and a fire to keep it warm. Radiant warmers are available these days for this use. In order to prevent the infant from becoming infected, stringent aseptic precautions are part of modern neonatal

care. Sepsis and antisepsis measures, such as washing hands and surfaces, using sterile surgical instruments (blade or scissors), handling the cord in a clean manner, wearing surgical masks and gloves, etc., must be strictly adhered from the beginning of the birth process until the newborn is handled and resuscitated. Throughout the neonatal care process, proper cleanliness is essential to reduce infection episodes. The same idea holds true for mother and child care as well. It is very clear that acharyas have well knowledge about antimicrobial efficacy of *Dhoopan karma* as a purpose of *rakshoghna karma*.all the drugs mentioned for this purpose have *krimighna, kandughna, jantooghna,kusthaghna,vranaropana* etc. properties .

- we can correlate these properties with antimicrobial,bactericidal,anti inflammatory,cytotoxic potency based on experimental study. The phytochemical screening demonstrated the presence of different types of compounds like terpenoids, tannins, deoxy sugars, saponins, phenolic compouns, and flavonoids which may contribute for the antimicrobial action of the above medicinal plants.so it is evident that ancient neonatal care and modern neonatology is nothing but the modified version of technology .*kashyap* in *dhoopkalpa adhayay* explained 40 types of *dhoop* for various purpose.but we have make an universal combination of *dhoop* beneficial for child as because non availability and ethical issues of some materials/herbs in current time.from the above description. It is clear that there is various in vitro studies have been done to prove *Dhoopan karma* is efficacious as *rakshoghna karma*.
- Formaldehyde is used for O.T. fumigation : 500 ml diluted in 1 lit of water in 1000 cubic ft area.if concentration more than 2 ppm,it became carcinogenic and severe toxic.where as herbal drugs used for fumigation does not have strict guideline: 5 gm each of drug taken together for a chamber of size 11-12-13 cm^3 ,somewhere it is used as 3 gm of each drug,somewhere it is taken as 25 gm of each drug for 100 sq,ft area of room.basically standard NICU is 120-150 sq.ft area,so we can use 4-5 g of each drug /sq.ft area.
- *Dhoopan* can be given by *churna,vati,varti ,dhoop even kashay*,as we can found in ancient times.whwreas chemical disinfectant used only in liquid form.so we can say that bioavailability of *Dhoopan* drugs is more in comparison to chemical fumigation as found in various studies.
- Herbal drugs used for *Dhoopan* now a days is cost-effective in terms of formaldehyde/potassium permanganate soln. also, herbal drugs are readily available from nature and have been used since ancient times.
- Various toxicity study has been done where it is proven that formaldehyde is a potent carcinogen and hazardous for human beings when concentration is hampered. In contrast, herbal drugs showed both antimicrobial potency and cytotoxic, antioxidant,wound healing properties, etc.
- We have explained the antimicrobial spectrum [found in NICU] of various herbal drugs used for *Dhoopan*. In contrast, formaldehyde has a limited spectrum of antimicrobial coverage. Besides that, *dhoopan ayurvedic medicines* have a significant role in preserving the skin microbiota of neonates, as found in studies.
- In the case of the surface sampling technique, it is cost-effective to use methods like swab or gauze piece method in comparison to using the mold, whereas, for air sampling, it is easy and cost-effective to use a passive method such as the agar plate method; in comparison to an active method like the air sampler.
- Now, it's time to establish *Dhoopan karma* as a sterilization technique for clinical study. For this, proper ethical guidelines, standardized drug preparation and formulation, dose and dosage form,

duration of effect, and assessment are the first priority. Moreover, toxicity studies and any hazardous effect on children must also be evaluated.

CONCLUSION:

This type of fumigation technique became an essential part of infection control and hospital epidemiology activities in the current era due to the broad spectrum action *(Krimighna, Kandughna, Jantughna, or* antiseptic, anti-inflammatory, antibacterial, and anti-infective activity) of *Dhoopana Karma*.
However, much research is required to prove this scientific approach of *Dhoopana* for sterilization. These natural agents help to prevent diseases as well as mitigate the side effects of synthetic disinfectants.

IMPLICATION

There is a need to implicate *Dhoopan karma* in a broad spectrum for disinfection compared to toxicities of formalin / bacilloid fumigation in a hospital setup. The method of drug delivery via *Dhoopan (fumigation)* has various benefits, such as easier drug administration, increased bioavailability, and a high potential to cross the blood-brain barrier through the intranasal/inhalation route, which is also a field of future study.
Further, this review article will help develop a standard specific antimicrobial fumigation protocols with *Ayurvedic Dhoopana Dravya*

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