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An Appraisal on Antimicrobial Activity of Herbomineral Formulations

Review Article

Ehsan M[1], Patil S[2], Nandi M K[3*]

1. M.Pharm (Ay) Final Year Scholar, 2. Assistant Professor, Department of Rasa Shastra,
3. Associate Professor, Department of Medicinal Chemistry,
Faculty of Ayurveda, Institute of Medical Sciences, Rajiv Gandhi South Campus, Banaras Hindu University, Varanasi.

Abstract

In Ayurveda, many herbal, metal-mineral and herbomineral formulations are used as method of treatment in various diseases like *Jwara* (Fever), *Krmi Roga* (Microbial Infections), *Kushtha Roga* (Skin Disease), *and Sotha* (Inflammation). Microbial infection is now a leading cause of health problem and death. Both the practitioners and people are taking less interest to prescribe and take the modern antimicrobial drug, due to side effect and drug resistance. Recently, the world is looking towards Ayurvedic formulations as a replacement of anti-microbial drugs to counter microbial infection, due to fewer side effects and more compatibility to our body. These anti-microbial activities may be due to specific secondary metabolites or complex of phytomolecules with suitable mineral components. In this review we have studied about some herbomineral formulations that have shown antimicrobial property in experimental studies. The study has included the method of preparation of herbomineral formulations mentioned in authentic classical Ayurveda texts like *Rasa Tarangini*, *Bhaishajya Ratnavali*, etc. the experimental methods used for antimicrobial susceptibility testing and the results of the study against the microbes. In addition to that the study has also included other therapeutic potentiality of these herbomineral formulation. The classical herbomineral formulations used for study in this review are found to be more effective against several microbe as compared to standard modern anti-microbial drug. This review will helpful for the researcher in various approaches of these Ayurvedic herbomineral formulations in the field of microbiology and antimicrobial treatment.

Key Words: *Malhara, Mrityunjaya Rasa, Rasa Karpoor, Swasakuthara, Vyadhividhwansana.*

Introduction

In Ayurveda pharmaceuticals, herbomineral formulations hold an important place. About 70 percent of Ayurvedic formulations consists of a mixture of one or more metal/minerals with several plant drugs which act as supporting role in enhancing the efficacy, relieve symptoms of ailments and to gain long and healthy life (1, 2).

Ayurveda includes both preventive and curative means of treatment, in Ayurvedic classical texts the pathogenesis of various diseases is well explained along with treatment. *Krimi* is one such causing agent, responsible for the production of various diseases. In Ayurveda, the word *Krimi* means visible or invisible minute organisms that survive on living or nonliving things. *Agnivesha* has explained the *Adrishta* (invisible) *Krimi*, while describing the *Raktaja Krimi* (3).

In modern medicine these *Krimi* are denoted as microbes that causes infectious diseases. The entire pandemic that is occurred in the world is due to these *Krimi*. The modern treatment available for the management of these diseases that occurs due to *Krimi* is antimicrobial agents like Chloramphenicol, Tetracycline and Ampicillin etc. The long term uses of these antimicrobial agents cause various side effect and drug resistance. These factors lead to ban of several antimicrobial agent or their limited uses. In Ayurvedic system of medicines, the microbial infections are treated with herbal and herbomineral formulation. In herbomineral formulations, metallic components are the essential part of preparation with plant parts. The metallic components are not in free form, they are in complex form with organic components. This combination is achieved by selective Ayurvedic procedure like *Sodhana* and *Marana*. This procedure reduces the toxic effects of metallic components and enhances the potency of the preparation. The phytomolecules or complexes of phytomolecules with metallic component present in the herbomineral dosage forms are very effective against microbes. Recently, researches also experimentally proven that incorporation of some metal or minerals with organic molecules in Ayurvedic formulation have effective antimicrobial activity (4, 5).

*** Corresponding Author:**
Nandi M K
Associate Professor, Department of Medicinal Chemistry, Faculty of Ayurveda, Institute of Medical Sciences, Rajiv Gandhi South Campus, Banaras Hindu University,Varanasi. India.
Email Id: manmathk.nandi1@bhu.ac.in

Methodology

The literature available in the Ayurvedic classical texts, technical reports, online scientific journals, repositories, SciFinder, Google Scholar, MEDLINE,

EMBASE, Scopus directory were explored for searching out the anti-microbial activity of herbomineral formulations by applying the following keywords: "Antimicrobial", "Ayurveda Formulations", "Herbomineral", "Culture Media", "Krimi Roga", "Zone of Inhibition", "CLSI" with their corresponding medical subject headings (MeSH) terms using conjunctions OR/AND. The search was focused on ethnomedicinal and in vitro preclinical reports to understand the role of these herbomineral formulations in microbial infections. Most recent articles were given the preference to be included in this article, up to April 2021. Searches were restricted to the English language.

Materials and Methods

In this review, after analyzing several research articles and classical Ayurveda texts, we have selected twelve classical Ayurveda formulations that are basically herbomineral origin. The experimental study on these formulations has proven that these formulations have potential antimicrobial property and can be used as antimicrobial agents. All twelve formulations are listed in Table no. 1.

Tamra Bhasma

It was reported that the Ayurvedic formulation *Tamra Bhasma* was prepared by *Marana* (Incineration), the *Sodhita Gandhak* (purified sulphur) and *Shodhita Parad* (purified mercury) triturated well and converted to *Kajjali*. The kajjali preparation was ignited with 1000 cow dunk cakes for 10 times (6). Then the prepared *Bhasma* was studied for antimicrobial activity both in Gram-positive bacteria i.e. *Staphylococcus aureus* and Gram-negative bacteria i.e. *Escheria coli* at a concentration range of 0.1g to 0.0125g /ml by Well diffusion method. The study reported that the minimum bacterial growth inhibition concentration of *Tamra Bhasma* was 2.5mg/ml for Gram-negative bacteria and 1.25mg/ml for Gram-positive bacteria. Further, it was reported that the hepatotoxicity effect of *Tamra Bhasma* was neutralized during *Sodhana* process and other side effects was also not observed (7).

Rasa Karpoor

It was reported that the *Rasa Karpoor* was prepared by *Kupipakwa* method, in this herbomineral formulation *Gandhak* (Sulphur) was not used directly with *Parad* (Mercury), in fact *Gandhakamla* (sulphuric acid) was used to mix with *Parad* in a glass vessel then transferred to a metallic vessel where the mixture was heated till all the aqueous part of *Gandhakamla* (Sulphuric Acid) evaporated out. After this process equal amount of *Saindhav Lavan* (Rock salt) was added to it and all these contents were filled in a glass bottle and fixed in valuka yantra for *Jarana* (8). Gupta et al, studied the prepared *Rasa Karpoor* for anti-fungal activity against *Candida albicans, Aspergillus flavus* and the study was compared with standard drug fluconazole. The study reported that *Rasa Karpoor* at dose range 50µg/ml and 100µg/ml showed the zone of inhibition was 29mm and 32 mm for *Candida albicans,* and 28.66 mm and 31.50 mm for *Aspergillus flavus*. The study reported that the polyherbal formulation *Rasa Karpoor* had much better anti-fungal activity compared to standard Fluconazole (9).

Swaskuthar Rasa

Das et al, reported that *Swaskuthar Rasa* was prepared by *Mardana* (trituration) process, using well dried powder of *Sunthi* (*Zingiber officinale* Roxb.), *Pippali (Piper longum* Linn.*), Maricha (Piper nigrum* Linn.*), Shodita Vatsanabh* (*Aconitum ferox* Wall ex Seringe), *Shodhita Manahshila (Purified Realgar)* and *Kajjali* which was prepared by *Mardan* of *Parad* and *Gandhak* in equal quantity. All the ingredients were mixed and small pellets were prepared after trituration with *Adraka swarasa* (Ginger expressed juice) (10). The collected *Swaskuthar Rasa* was studied against four strain of *Staphylococcus aureus* to determine the zone of inhibition by agar disc diffusion method and MIC (Minimum inhibitory concentration) value was also studied against bacterial strain i.e. *Staphylococcus aureus, Escheria coli, Pseudomonas, Salmonella typhimerum, Moeganella, Shingella, Klebsiella pneumoniae and Serratia.* The study reported that the *Swaskuthar Rasa* was found to be effective against 3 strains of *Streptococcus aureus* and susceptible for all the microbes except *Klebsiella pneumonia* and the MIC value (Minimum Inhibitory Concentration) was reported for all organism and most effective against *Staphylococcus aureus* and *Escheria coli*. In this study ciprofloxacin was used as standard drug for comparative study (11).

Rajat Bhasma

It was reported that *Rajat Bhasma* was prepared by *Mardan* of *Shodhita Hartala* (Purified Orpiment) and *Shodita Gandhak* (Purified Sulphur) with *Rajat Patra* (thin sheets of silver), after this process three subsequent *Putas* (Heat) was given and Collyrium like bhasma was prepared (12). Further, the preparation of *Rajat Bhasma* and its silver nanoparticles were studied against two Gram-positive bacteria i.e. *Bacillus subtilis*, *Staphylococcus aureus* and two Gram-negative bacteria i.e. *Escheria coli, Klebsiella pneumonia* to evaluate the antimicrobial activity. The study was done by using the agar well diffusion method by growing the culture suspensions with a concentration of 1-2×10^8CFU/ml. The reported zone of inhibition was found largest in *Staphylococcus aureus* i.e. 29 mm and other strains were registrant to *Rajat Bhasma* and its silver naoparticle. The study was compared with Streptomycin Sulphate as standard antimicrobial agent (13).

Vyadhividhwansana Rasa

The study reported that the *Vyadhividhwansana Rasa* was prepared by *Mardana* (trituration) process after purification of *Abhraka* (Mica) and detoxification of toxic ingredients like *Vatsnabha* (*Aconitum ferox* Wall ex Seringe), *Tankan (Borax, Jayapala (Croton tiglium* Linn.*), Parada (Purified Mercury)* and *Gandhaka (Sulphur). Shodhit Parad* and *Shodhit Gandhak* was used to prepare *Kajjali, Maradan* process, followed by other the ingredients were mixed by

trituration. Then *Bhavana* was given to the mixture by using *Bhringraja Swaras (*Expressed juice of *Eclipta alba* Hassk) to prepare the formulation (14). The study reported the *Vyadhividhwansana Rasa* was evaluated for antimicrobial activity against five bacteria strains i.e. *Escheria coli, Streptococcus pyogens, Staphylococcus aureus, Pseudomonas aeruginosa and Salmonella typhi* by agar well diffusion method in Muller-Hinton agar (MHA) plate at three concentrations (50, 100 and 150 mg/ml in 20% DMSO) and streptomycin was used as standard. The efficacy of *Vyadhividhwansana Rasa* was reported as 4-34 mm zone of inhibition in different strain and highest susceptible towards *Staphylococcus aureus* (15).

Tankanamruta Malhara

The preparation of *Tankanamruta Malhara* was done by general mixing of ingredients by help of palm to get homogenous, ointment like consistency. The *Siktha Taila* (mixture of bee wax and sesame oil) and *Shodhita Tankan* (purified borax) mixed vigorously till the tankan get mixed properly, then *Sarjikshar* (*Fagonia Arabica* Linn.)*, Shodita Pushpa Kashish* (purified green vitriol) and *Pipal Twak Kshar* (*Ficus riligiosa* Linn. bark) were mixed till it get proper consistency (16). After the formulation was prepared, the antimicrobial activity was evaluated against one Gram-positive bacteria i.e. *Staphylococcus aureus* and one Gram-negative bacteria i.e. *Pseudomonas aeruginosa*, this study was done by using disc diffusion method and the media used was Soya Bean Casein Digest Agar. The study reported that the formulation had good antimicrobial activity against both bacteria and the reported MIC value (Minimum Bacterial Concentration) was 1% and the zone of inhibition was 12 mm for both the bacteria. Further, the study was compared with the antibacterial effect of Soframycin as standard. The study also reported about the physico-chemical parameters like physical appearance, pH, skin irritation and rancidity test to standardize the formulation (17).

Rasa Sindoor

It was reported that the Ayurvedic herbomineral formulation *Rasa Sindoor* was prepared by *Kupipakwa* method. *Hingula* (Cinnabar) was purified by *Nimbu Swaras* (lemon juice) and the *Shodhita Hingula* triturated well with *Shodhita Gandhak*. Then the mixture was filled in a glass bottle and placed in the *Valuka Yantra* to ignite the mixture and converted to *Rasa Sindoor* (18). This formulation was studied for antimicrobial activity against two Gram-positive bacteria i.e. *Staphylococcus aureus* and *Salmonella typhi* and two Gram-negative bacteria i.e. *Pseudomonas aeruginosa* and *Escheria coli.* In this study both agar well diffusion and disc diffusion method was used, to evaluate the five concentration of *Rasa Sindoor* i.e. 0.10, 0.20, 0.30, 0.40 and 0.50 mg.ml. The reported zone of inhibition was concentration dependent and effective against all bacteria. Further, the study reported highest and lowest maximum zone of inhibition was observed against *Escheria coli* and *Pseudomonas aeruginosa* respectively (19).

Mrityunjaya Rasa

The study, reported that the *Mrityunjaya Rasa* was prepared by using *Mardan* (trituration) and *Bhawana Process* (levigation). This Ayurvedic formulation was achieved by mixing powdered *Shodhita Vatsnabha* and *Shodhita Hingula* in mortar. Then *Shodhita Gandhak, Shodhita Tankan*, fine powder of *Maricha* and *Pippali* were mixed thoroughly. Finally, *Adraka Swarasa* (ginger juice) was added till all the ingredients got immersed into it, followed by *Bhawana* process was done till it dried to suitable consistency (20). The prepared herbomineral formulation was extracted with different solvents i. e. water, ethanol, chloroform and benzene and theses extracts were used in the study to evaluate antibacterial activity against *Escheria coli, Pseudomonas aeurginosa,* and *Staphylococcus aureus* by disc diffusion method. The study reported that the zone of inhibition was maximum against *Staphylococcus aureus* by all the extract and highest by aqueous extract (21).

Agrawal *et al.,* also studied the antimicrobial activity of *Mrityunjaya Rasa* against *Streptococcus pyogenes*, *Escheria coli, Pseudomonas aeurginosa, Salmonella typhi* and *Staphylococcus aureus* by well diffusion method using Mueller- Hinton Agar media. The herbomineral formulation was evaluated at three conc. i.e. 5%, 10% and 12.5% and the study reported that zone of inhibition by the preparation was maximum against *Streptococcus pyogenes,* moderate against *Staphylococcus aureus* and no sensitivity against other three microbes. In both the study, Streptomycin was used as standard to compare the effectiveness of formulation as antimicrobial agents.

Seetamshu Rasa

It was reported that *Seetamshu Rasa* was prepared by *Mardana* process, for the preparation of this Ayurveda herbomineral formulation, all the ingredients (Mentioned in Table no. 1) were mixed and triturated with sufficient amount of *Nimbu Swarasa* (Lemon Juice) to get a consistency suitable pellet forming by rolling between fingers (22). The *Seetamshu Rasa* was studied for antimicrobial activity against two Gram-positive i.e. *Staphylacoccus aureus, Escheria coli*, two Gram-negative bacteria i.e. *Pseudomonas aeruginosa, Klebsiella pneumonia* and one fungus i.e. *Candida albicans* by disc diffusion method using Mueller Hinton Agar. The study reported that the zone of was maximum for *Escheria coli* followed by *Staphylococcus aureus, Klebsiella pneumonia and Pseudomonas aeurginosa* respectively and the antibacterial activity was compared with streptomycin as standard drug. Further, the study reported about the antifungal potential of *Seetamshu Rasa* against *Candida albicans* with a zone of inhibition was 17 mm and the study was compared with standard drug Itraconazole as antifungal agent (23).

Udayabhaskara Rasa

It was reported that the *Udaybaskara Rasa* was prepared by *Mardan* (trituration) and *Bhawana* (levigation) process, for preparation of this

herbomineral formulation, *Sudha Parad* was triturated with *Rasa Karpoora,* then *Trilavana* i.e. Saindhav, Suavarchala and *Vida Lavana* were mixed and triturated, after that all the powdered ingredients were added into it, at last seven *Bhawana* were given by *Bijapuraka Swaras* till it get dried. The obtained *Udaybhaskar rasa* was studied for antimicrobial activity against the five different pathogenic bacteria i.e. *Staphylococcus aureus, Streptococcus pyogens, Escherichia coli, Pseudomonas aeurginosa, Salmonella typhi* by disc diffusion method using Mueller Hinton Agar. The study reported that the mean value of zone of inhibition was 20 mm for *Streptococcus pyogens*, 35.5 mm for *Staphylococcus aureus*, 22.5 mm for *Escherichia coli*, 33.5 mm for *Pseudomonas aeurginosa* and 30.5 mm for *Salmonella typhi.* This study reported that *Udayabhaskara Rasa* is susceptible to all the five different bacterial strains, but it is highly susceptible to two bacterial strains i.e. *Staphylococcus aureus* and *Pseudomonas aeurginosa* (24).

Gandhak Taila

It was reported that the *Gandhak Taila* was prepared by mixing the *Sudha Gandhak* with sufficient amount of butter and smeared this sticky mixture on a square shaped cotton cloth which was previously smeared with *Ark* (*Calatropis procera*) plant latex and *Snuhi* (*Euphorbia mili*) plant latex. After this process rolled this cloth and tied with thread then it was ignited and the melted Gandhak Tail collected in a glass container (25). The prepared *Gandhak Tail* was studied for antimicrobial activity against two Gram-positive bacteria i.e. *E. coli, Staphylococcus aureus* and one fungus strain i.e. *Candida albicans.* The sample was prepared by melting the *Gandhak Tail* by heating it at 42°C in water bath, and then it was added in the nutrient broth at 40°C aseptically, after that vigorous shaking was done and cooled the system at 30°C. After that 1 ml of cell suspension with approximate 1.4×10^2 cells/ml was and several readings of zone of inhibition were taken after 24hrs, 48hrs and 72 hrs respectively. This study reported that no growth was seen in any stage of observations at different time intervals (26).

Gandhak Dhruti

It was reported that the *Gandhak Dhruti* was prepared by *Mardana* (trituration) and ignition process. For preparation of this herbomineral formulation *Shudha Gandhak* was mixed with *Trikatu* (combination of *Sunthi (Zingiber officinale* Roxb.*), Pippali (Piper longum* Linn.*) and Maricha (Piper nigrum* Linn.) by trituration. Then the mixture got smeared on a square shaped cotton cloth, rolled it and tied with thread, then it was immersed in *Tila Taila* of sufficient quantity for 3hrs. The rolled cloth was removed from *Tila Taila* and ignited in fire and the drops dribbling were collected in glass container (27). The obtained *Gandhak Dhruti* was studied for antimicrobial activity against two bacterial strains i.e. *Staphylococcus aureus, Pseudomonas aeurginosa* and one fungus strain i.e. *Candida albicans.* In this study Cup plate method was used for susceptibility testing of test drug. This study reported that the herbomineral formulation *Gandhak Dhruti* was found to be susceptible only for *Candida albicans* by reporting the zone of inhibition value 18mm (28).

Table No. 1: Details about the ingredients of the formulations with reference

Sr. No.	Formulation	Ingredients	Latin Name	Quantity	Reference
1	*Tamra Bhasma*	Shudha Parad	Mercury (Purified)	1 Part	(6)
		Shudha Gandhak	Sulphur (Purified)	1 Part	
		Shudh Tamra	Copper (Purified)	1 Part	
		Nimbu Swarasa	*Citrus limon* (Linn.) Burm. f.	Q.S.	
2	*Rasa Karpoor*	Shudha Parad	Mercury (Purified)	1 Part	(8)
		Gandhakamla	Sulphuric Acid	1.5 Part	
		Saindhav Lavana	Rock Salt	Q.S.	
3	*Swasakuthara Rasa*	Shudha Parad	Mercury (Purified)	1 Part	(10)
		Shudha Gandhak	Sulphur (Purified)	1 Part	
		Shudha Sohaga	Borax (Purified)	1 Part	
		Manahshila	Realgar (Purified)	1 Part	
		Maricha (Fr.)	*Piper nigrum* Linn.	1 Part	
		Pippali (Fr.)	*Piper longum* Linn.	1 Part	
		Sunthi (Rz.)	*Zingiber officinale* Roxb.	1 Part	
4	*Rajat Bhasma*	Shudha Rajat	Silver (Purified)	1 Part	(12)
		Shhudha Hartala	Orpiment (Purified)	1 Part	
		Sudha Gandhaka	Sulphur (Purified)	1 Part	
5	*Vyadhividhwansana Rasa*	Abhraka Bhasma	Mica (Incinarated)	1 Part	(14)
		Shudha Gandhaka	Sulphur (Purified)	1 Part	
		Shudha Parada	Mercury (Purified)	1 Part	
		Sunthi (Rz.)	*Zingiber officinale* Roxb.	1 Part	
		Maricha (Fr.)	*Piper nigrum* Linn.	1 Part	
		Pippali (Fr.)	*Piper longum* Linn.	1 Part	
		Vatsanabha (Sd.)	*Aconitum ferox* Wall ex Seringe (Purified)	1 Part	

		Tankana	Borax (Purified)	1 Part	
		Shudha Jayapala (Sd)	*Croton tiglium* Linn. (Purified)	16 Part	
6	*Tankanamruta Malahara*	Tankana Bhasma	Borax (Incinarated)	24g	(16)
		Shudha Pushpa Kasis	Green Vitriol (Purified)	6g	
		Sarjikshara	*Fagonia Arabica* Linn. (Incinarated)	6g	
		Pipal Twak Kshar	*Ficus religiosa* Linn. (Incinarated)	2g	
		Siktha Tail	-	144g	
7	*Rasa Sindoora*	Shudha Hingula	Cinnabar (Purified)	1 Part	(18)
		Shudha Gandhak	Sulphur (Purified)	1 Part	
		Nimbu Swarasa	*Citrus limon* (Linn.) Burm. f.	Q.S.	
8	*Mrityunjaya Rasa*	Shudha Hingula	Cinnabar (Purified)	2.5 Part	(20)
		Shudha Gandhak	Sulphur (Purified)	1 Part	
		Shudha Tankana	Borax (Purified)	1 Part	
		Vatsanabha (Sd.)	*Aconitum ferox* Wall ex Seringe (Purified)	1 Part	
		Maricha (Fr.)	*Piper nigrum* Linn.	1 Part	
		Pippali (Fr.)	*Piper longum* Linn.	1 Part	
		Adraka Swarasa	*Zingiber officinale* Roxb. (Juice)	Q.S.	
9	*Seetamshu Rasa*	Shudha Hartala	Orpiment (Purified)	1 Part	(22)
		Shudha Manahshila	Realgar (Purified)	1 Part	
		Sunthi (Rz.)	*Zingiber officinale* Roxb.	2 Part	
		Pippali (Fr.)	*Piper longum* Linn.	2 Part	
		Maricha (Fr.)	*Piper nigrum* Linn.	2 Part	
		Nimbu Swarasa	*Citrus limon* (Linn.) Burm. f.	Q.S.	
10	*Udaya bhaskar Rasa*	Shudha Parad	Mercury (Purified)	1 Part	(24)
		Shudha Gandhak	Sulphur (Purified)	1 Part	
		Sunthi (Rz.)	*Zingiber officinale* Roxb.	1 Part	
		Pippali (Fr.)	*Piper longum* Linn.	1 Part	
		Maricha (Fr.)	*Piper nigrum* Linn.	1 Part	
		Saindhava Lavana	Rock Salt	1 Part	
		Sauvarchala Lavana	Black Salt	1 Part	
		Vida Lavana	Ammonium Chloride	1 Part	
		Sita	Crystalline Sugar	1 Part	
		Dhanyaka	*Coriandrum sativum* Linn.	1 Part	
		Brihad Ela	*Amomum subulatum* Roxb.	1 Part	
		Rasa Karpoor	Mercuric Chloride	1 Part	
		Sudha Jaipala (Sd.)	*Croton tiglium* Linn.	12 Part	
		Bijapuraka Swarasa	*Citrus medica* Linn.	Q.S.	
11	*Gandhak Taila*	Shudha Gandhak	Sulphur (Purified)	1 Part	(25)
		Snuhi (Lt.)	*Euphorbia mili* Des Moul.	Q.S.	
		Arka (Lt.)	*Calotropis procera* (Ait) R. Br.	Q.S.	
		Navneet	Butter	Q.S.	
12	*Gandhak Dhruti*	Shudha Gandhak	Sulphur (Purified)	80gm	(27)
		Sunthi (Rz.)	*Zingiber officinale* Roxb.	2gm	
		Pippali (Fr.)	*Piper longum* Linn.	2gm	
		Maricha (Fr.)	*Piper nigrum* Linn.	2gm	
		Tila Taila	*Sesamum indicum* Linn.*seed oil*	Q.S.	

Other therapeutic effects

It was reported that all the twelve formulations have antimicrobial potential but these formulations also reported for some other therapeutic effects other than antimicrobial effect, as listed in table no- 2

Table no.2: Herbomineral formulations with their therapeutic effects other than the antimicrobial effect

Sr. No.	Formulation	Therapeutic Effects / Indications
1	*Tamra Bhasma*	Anticancer Effect (38), Gastric Ulcer, Hipolipidimic Effects, Antianaemic, Cardiac Diseases (39, 40, 41).
2	*Rasa Karpoor*	Diarrhea and Dysentery (8)
3	*Swaskuthar Rasa*	Anticancer effect (38), Respiratory diseases (42)

4	*Rajat Bhasma*	Used in irritable bowel syndrome, Acidity (43)
5	*Tankanamruta Malhara*	*Dushta Vrana* (Ulcer) (44)
6	*Rasa Sindoor*	Alzheimer's Disease (45), Cancer (46)
7	*Mrityunjaya Rasa*	All types of Fever (18), Immunomodulator (47)
8	*Sheetamshu Rasa*	Emphysema (48)
9	*Vyadhividhwansana Rasa*	*Vishamjwara* (irregular fever) (49)
10	*Udayabhaskara Rasa*	*Vicharchika* (Eczema) (50)
11	*Gandhak Tail*	*Visarpa*, *Shudra Kushtha* (Skin Disease) (25)
12	*Gandhak Dhruti*	*Pandu Roga* (Anemia), Respiratory Diseases (27)

Results & Discussion

In this review, we have analyzed many herbomineral formulations from classical Ayurveda texts and some research articles, here we have discussed some points related to our study as follows-the antibacterial action of *Tamra Bhasma* i.e. *Krimighna* action as mentioned in Ayurveda texts is recognized (29). *Tamra Bhasma* was found to be effective against *Escheria coli* and *Staphylococcus aureus (30)*. *Rasakarpoor* was found to be more effective than standard antifungal drug Fluconazole, should be tried in clinical trials and *Rasakarpoor* could be a good alternative of Fluconazole (31). *Swaskuthara Rasa* was found to effective against the *Klebsiella pneumonia* (32). *Rajat Bhasma* shown significant results on Gram positive bacteria (33). Herbal drugs used in these herbomineral formulations itself have significant antimicrobial property like-*Vatsnanabha* (*Aconitum ferox* Wall ex Seringe) (34), *Sunthi* (*Zingiber officinale Linn.*) (35). *Tankan* (Borax) is effective against some bacterial strains (36). Piperine obtained from *Pippali* (*Piper longum* Linn.), also exhibit antimicrobial property against Gram positive bacteria (37). Many other therapeutic effects and uses were recorded for these twelve herbomineral formulations, by which we get some more ideas of research on these herbomineral formulations.

Conclusion

In this review we concluded that all the 12 herbomineral formulations used for antimicrobial study were found to be susceptible for microbes. After analyzing the significant zone of inhibition and minimum inhibition concentrations for respective pathogens that we face in our daily life, it seems that the herbomineral formulations with minimal dose could be a good alternative option to modern antimicrobial drug which causes many adverse effects and drug resistance in several types of microbial infections. These herbomineral formulations should be tried in clinical trials and requires more research regarding to standardization and therapeutic efficacy. Current review will be helpful for research and pharmaceutical standardization purpose of classical herbomineral formulations.

Conflict of Interest: Nil

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