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Review Article

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"RASA AS A PREDICTOR OF CHEMISTRY AND ACTION: A CRITICAL REVIEW OF STUDIES CORRELATING AYURVEDIC TASTE CATEGORIES WITH PHYTOCHEMICAL CLASSES, SENSOR DATA AND PHARMACOLOGICAL ACTIVITY"

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ABSTRACT

In classical Dravyaguna, rasa (taste) is the first and most accessible property of a drug. It is held to reflect the drug's elemental composition (panchamahabhuta) and to predict its actions on the dosha and tissues. Modern research has begun to test whether rasa categories correspond to measurable chemistry and to recorded pharmacological activity. This review appraises three lines of evidence. First, in a database of 183 Ayurvedic plants, predominant taste was significantly associated with ethnopharmacological actions, with 109 significant taste–action associations, only four of which contradicted traditional sources. A companion database links 431 Ayurvedic plants to 438 identified tastant molecules. An independent analysis of 700 drugs from Dioscorides' *De Materia Medica*, rated by a trained sensory panel, found that taste qualities predicted therapeutic uses, with bitterness associated with therapeutic versatility. Second, electronic-tongue and spectroscopic studies distinguished sweet from bitter plants well, sweet plants resembling sucrose. Separation of pungent, sour and astringent groups was less clear, and bitter plants did not match caffeine or quinine standards. Thin-layer chromatography has localised astringent-tasting, tannin-containing fractions. Third, the discovery of taste receptors outside the mouth, in the gut, airways, heart and elsewhere, offers a plausible mechanism by which taste-active compounds could have systemic effects. Taken together, the evidence supports rasa as a meaningful, if coarse, descriptor of chemistry and action. It also shows that classical rasa assignments need reproducible sensory methods. We propose a research agenda combining trained sensory panels, chemical profiling and receptor pharmacology.

KEYWORDS: Rasa, taste, Dravyaguna, electronic tongue, bitter taste receptors, TAS2R, phytochemistry, ethnopharmacology

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INTRODUCTION

In the twenty-sixth chapter of the Sutrasthana, Charaka sets out the theory that rasa (taste) arises from the predominance of particular mahabhuta in a substance and that each of the six rasa – madhura (sweet), amla (sour), lavana (salty), katu (pungent), tikta (bitter) and kashaya (astringent) – has characteristic actions on the dosha and tissues.[1] Rasa is therefore the first property by which a physician infers the composition and action of an unknown drug, before considering virya, vipaka and prabhava.[1] Taste can be perceived directly, which makes it both the most practical and the most testable of the Dravyaguna properties.

If rasa reflects composition and predicts action, three things should follow: drugs of the same rasa should share chemical features; taste-based categories should be distinguishable by instruments; and taste should predict recorded therapeutic uses. A mechanistic link between taste and systemic action would make these correlations more than coincidence. This review examines the evidence for each.

METHODS

This is a critical narrative review. We searched PubMed, publisher websites and open repositories for studies that related Ayurvedic or other traditional taste categories to chemical composition, instrumental sensory data or pharmacological activity, and for reviews of extra-oral taste receptors.

TASTE AND RECORDED ACTION

The most direct test of the rasa theory is whether taste predicts the actions recorded for a drug. Gilca and Barbulescu built a database of 183 Ayurvedic plants and their 121 recorded ethnopharmacological actions and found a statistically significant overall association between predominant taste and action.[2] Of 109 significant individual taste–action associations, 24 were not mentioned in traditional sources and only four contradicted them.[2] A companion database, PhytoMolecularTasteDB, links 431 Ayurvedic plants to 438 identified taste-active molecules from 223 phytochemical classes, allowing a plant's "molecular taste" to be compared with its classical rasa.[3]

Because these analyses use Ayurvedic sources for both taste and action, they could partly reflect internal consistency within the tradition rather than independent prediction. An analysis from outside Ayurveda avoids this problem. Leonti and colleagues had a trained panel taste 700 botanical drugs described by Dioscorides and found that 21 of 22 taste and flavour qualities predicted at least one therapeutic use. Intense, simple tastes were associated with greater therapeutic versatility, and bitterness in particular was positively associated with versatility.[4] That a link between taste and use appears in an independent Mediterranean pharmacopoeia, assessed by a modern sensory panel, strengthens the case that taste carried real information for traditional physicians.

TASTE AND CHEMISTRY

Table 1 summarises instrumental studies of rasa.

Table 1. Instrumental and chemical studies of Ayurvedic rasa categories.

Study	Plants and method	Main finding	Limitation
Jayasundar and Ghatak, 2016[5]	7 plants; E-tongue, NMR, FTIR, LIBS	Sensor and NMR profiles similar within sweet and within pungent groups	Very small sample
Jayasundar et al., 2022[6]	78 plants in 5 rasa groups; E-tongue with multivariate analysis	Sweet plants matched sucrose; sweet and bitter strongly separated; bitter plants did not match caffeine or quinine	Sour group of 4 plants; no pungent or astringent standards; preliminary
Kolhe et al., 2014[7]	2 astringent drugs; TLC with taste panel	Tannin-containing zone tasted astringent to volunteers	5 volunteers

Electronic tongues distinguish sweet from bitter plants convincingly, and sweet plants resemble sucrose in their sensor responses.[6] This is expected, since sugars are the main tastants of many sweet drugs. Bitter plants did not resemble caffeine or quinine,[6] which is consistent with the great chemical diversity of bitter compounds, including alkaloids, terpenoid lactones, glycosides, flavonoids and phenols.[8] Bitterness is therefore not a marker of one chemical class but of many. The same is true of pungency, which may come from alkaloids such as piperine, from phenolic ketones such as gingerols, or

from sulphur compounds. Astringency, by contrast, has a relatively specific chemical basis in tannins and related polyphenols, and a thin-layer chromatography study localised the astringent taste to a tannin-containing fraction.[7]

The overall picture is that rasa corresponds to chemistry at the level of broad functional categories – sugars, tannins, bitter and pungent compounds – rather than specific chemical classes. This is what a sensory classification should be expected to achieve.

A MECHANISM: TASTE RECEPTORS BEYOND THE MOUTH

For taste to predict systemic action, there must be a plausible link between taste-active compounds and the body's response beyond the tongue. The discovery that taste receptors are expressed throughout the body provides one. Sweet, umami and bitter receptors are found in the gut, where they regulate hormone secretion, motility and immune responses; bitter receptors in the airways increase ciliary beating and relax smooth muscle; and taste receptors are present in the heart, brain and urogenital system.[9] A drug that activates bitter receptors in the gut or airways could therefore produce effects that classical texts attribute to tikta rasa, such as improving digestion or clearing kapha. This does not prove the classical claims, but it shows that taste-mediated systemic actions are biologically possible.

A DRAVYAGUNA PERSPECTIVE

The evidence supports rasa as a meaningful descriptor. Taste is associated with recorded actions in Ayurveda and in an independent tradition, it corresponds to broad chemical categories, and a receptor-based mechanism exists. At the same time, the evidence shows the limits of rasa as a predictor. Many plants have more than one rasa, and the classical rasa of a drug is not always confirmed by modern tasting; assignments may also depend on which plant is used under a given name.[10] Classical texts themselves acknowledge that rasa is overridden by virya, vipaka and prabhava in some drugs,[1] which is consistent with its role as a first approximation rather than a complete description.

RESEARCH AGENDA

- Re-establish the rasa of key Ayurvedic drugs with trained sensory panels using standard sensory-science methods, as done for Dioscoridean drugs.[4]
- Combine sensory data with chemical profiling and molecular taste databases[3] to identify the tastants responsible for each rasa.
- Test whether rasa predicts activity on extra-oral taste receptors and on related physiological endpoints.[9]
- Use prospective designs in which predictions from rasa are made before activity is measured, avoiding circularity.[2]
- Authenticate plant material so that rasa assignments refer to a defined species.

LIMITATIONS

The number of instrumental studies is small and most are preliminary. Database studies depend on secondary sources for both taste and action. This review is narrative and does not include studies published in languages other than English.

9. CONCLUSION

Rasa is not a mystical category but an organised sensory classification that carries real information about chemistry and action. Studies of Ayurvedic and Dioscoridean drugs show that taste predicts recorded uses, instruments can distinguish at least the sweet and bitter groups, and extra-oral taste receptors offer a mechanism. Rasa is a coarse predictor that needs reproducible sensory methods and should be combined with modern chemistry and receptor pharmacology. Used in this way, the oldest step in Dravyaguna reasoning can become a useful tool in drug discovery.

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