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Consequences of excessive use of *Amlarasa* (sour taste): A case-control study

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Abstract

Background: Palatability is an important factor for choice of food by an individual. *Amlarasa* (sour taste) is one of the main organoleptic entities in foods of present day, which always tempts the consumer to take it now and then. According to classical Ayurvedic texts, balanced intake of *Amlarasa* in diet helps to maintain physiological health, but its excessive intake produces some signs and symptoms such as dentine hypersensitivity, stomatitis, halitosis, heartburn, urticaria, papule and joint inflammation. **Aim:** To establish the relationship between excessive use of sour predominant diets and signs/symptoms produced by it. **Materials and Methods:** A case-control survey study was designed wherein total of 178 volunteers were interviewed personally. Subjects with particular symptoms consider as a cases while healthy volunteers as controls. To measure the excessive intake of *Amlarasa*, quantity and frequency of common food articles such as mango, tomato, lime, butter milk, tamarind, curd, fermented items etc., are taken into consideration. Data was arranged in to 2 × 2 table and odd ratio was calculated for each symptom. **Results:** Odds ratio for dentine hypersensitivity, stomatitis, halitosis, heartburn, urticaria, papule and joint inflammation with 95% confidence interval were found 1.95 (0.97-3.93), 2.45 (1.12-5.40), 2.76 (0.96-7.98), 2.21 (1.09-4.53), 0.86 (0.32-2.32), 2.28 (1.02-5.05) and 4.85 (1.09-10.24) respectively. **Conclusion:** Study reveals that *Amlarasa* is a risk factor for joint inflammation, dentine hypersensitivity, stomatitis, halitosis, heartburn and papules. Study supports the Ayurvedic classical claim regarding *Atiyoga* of *Amlarasa*.

Key words: *Amlarasa*, *Atiyoga*, excessive intake, sour taste, survey

Introduction

There are a number of factors that affect an individual's choice of food, of which palatability forms an important factor. Palatability of each taste (*Rasa*) is different and it is reported that, consumption of food depends on palatability.[1] As palatability of sour and spicy taste is higher it is observed that intake of fast-food, which is predominantly sour and spicy among the people is very high.[2,3] *Amlarasa* (sour taste) is one of the main organoleptic entities in foods of present day which always tempts the consumer to take it now and then. This fact can also be observed in the classical text of Ayurveda with a quote "*Amlam Hridyanam*" (sour taste is pleasant to mind/heart).[4]

It is evident from the ancient literature that one has to consume all the six tastes, i.e, *Madhura* (sweet), *Amla* (sour), *Lavana* (salty), *Katu* (pungent), *Tikta* (bitter) and *Kashaya* (astringent) in a balanced way and over use of any of them can show adverse effect on the body.[5] Balanced use of *Amlarasa* in the diet stimulates digestion (*Pachayati*) and appetite (*Agni Dipayati*), increases salivation (*Asyam Sravayati*), improves the taste (*Rochayati*), is good for heart (*Hridayam Tarpayati*), sharpens the mind (*Mano Bodhayati*) and strengthens the sense organ (*Indriyani Dradhikaroti*).[6] On the other hand, excessive use produces some signs and symptoms such as dentine hypersensitivity (*Dantaharsa*), increase in the thirst (*Trishna*), contraction of the eyes (*Aksinmilana*), piloerection (*Samvejayati lomani*), aggravates *Kapha Dosha* through dilution (*Kapha Vilapayati*), increases *Pitta Dosha* (*Pittam Abhivardhayati*), vitiates blood (*Raktam Dushayati*), produces wasting of muscular tissue (*Mansadhatu Vidaha*), loosens of body (*Sharira Shaithilaya*), edema/inflammation in emaciated persons (*Durbalanam Swayathu Apadayati*), suppuration in wounds, burns or fractures or swelling (*Doshapachana* of *Kshata*, *Dagdha*, *Bhagna*, *Sotha*), burning sensation in throat, heart and chest (*Paridahati Kanthamurohridaya*)[6] etc.

It is being observed, during patient interrogation, that more sour predominant food articles were being consumed in their diet. However, the relationship between excessive use of sour

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predominant diets and the disease conditions, related to it, has not been validated until date.

Moreover, a case-control survey study was appropriated to find out relationship between these two variables. Among all signs/symptoms mentioned by classics such symptoms like dentine hypersensitivity, stomatitis, halitosis, heartburn, urticaria, papule and joint inflammation were selected to justify the classical claim. Hence participant who have particular symptom was considered as case for that symptom.

Hence the present study, which could be relevant while advising diet to promote health and manage disease conditions, was designed to establish the relationship between excessive use of sour predominant diets and signs/symptoms produced by it.

Materials and Methods

A population (of cases) based case control study was conducted in resident area of Jamnagar city of Gujarat (India).

Cases

Subjects who have symptom of interest, i.e. dentine hypersensitivity or stomatitis or halitosis or heartburn or urticaria or papule or joint inflammation.

Controls

Subjects who were free from the above symptoms were being compared to cases.

The subjects who were suffering from above symptoms (clinically diagnosed at study sites) were selected. To assemble a control series for particular cases series, neighbor/colleague of these cases were interviewed. Open-ended questionnaire in both Gujarati and English language was designed especially for survey study.

Sampling method

Convenience sampling method, through which *Amlarasa* exposed persons can be traced easily, was applied for the study. Consumers at juice centers, morning and evening joggers and hostel students of the institution who are more prone to exposure of sour taste containing food articles like citrus fruits juice, cold drinks, *Nimbupani* (lime juice) etc., of either sex, belonging to the age group of 15-60 years, were personally interviewed. Taking the *Amlarasa Atiyoga* (excessive intake of sour predominant diets) into consideration, participants with excessive intake of sour predominant diets were considered under exposed group and participants with normal intake were considered under unexposed group.

Preparation of proforma

To measure the excessive intake of *Amlarasa*, a primary proforma [Table 1] was prepared based on the use of sour dominant food articles intake routinely in local population. In local population of Jamnagar sour dominant food articles such as mango, tomato, lime, butter milk, tamarind, curd and fermented items, are used in routine diet excessively and frequently. Consumption of each food article by people was recorded and categorized such as normal intake and excessive intake. For example, consumption of lime more than 2 pieces/day in various preparations for more than 1 month in last 1 year was considered as excess intake of the sour taste and participants with excess intake of the sour taste ultimately were categorized under exposed group (*Amlarasa Atiyoga* group) while those who consumed sour taste below this estimated level of lime categorized under unexposed group. Like lime quantification of excessive use for each sour food articles were also measured.

Statistical analysis

After collection of data, it was presented in 2 × 2 table for each symptom. The odds ratio for each symptom was analyzed to estimate the relative risk for a symptom in relation to a given risk factor (*Amlarasa Atiyoga*). Confidence interval (CI) (95%) was also analyzed to observe that data was whether statistically significant or not.

Result

A total of 178 volunteers were interviewed for the survey study. Patients with overuse of *Amlarasa* were distributed with regard to age and gender. Odds ratio with CI-95% was calculated accordingly [Table 2]. In relation to age group, the odds ratio was 1.48, 1.56, 2 in young, middle and old aged subjects respectively which indicates positive association between *Atiyoga* of sour taste and age. It may be due to decrease of tolerability toward sour taste as age progresses. No difference in odds ratio was observed in both male and female which reveals that there no relationship between *Atiyoga* of *Amlarasa* and gender.

Table 1: Prepared primary proforma to evaluate excessive use of sour taste

Sour taste predominant food articles	Occasionally/ seasonal/routine	Duration	ml/mg/ no./week	Upper limit for normal consumption (minimum for 1 month)	*Atiyoga* yes/no
Tamarind				50 g/week	
Lime				10 pieces/week	
Orange				10 pieces/week	
Grape				2 kg/week	
Mango				2 kg/week	
Butter milk				5 L/week	
Tomato				4 kg/week	
Curd				4 kg/week	
Soft drinks				2 L/week	
Fermented items				2 kg/week	

Cases and controls of each symptom according to exposure of excess sour taste are distributed in Table 3. 1.95 odds ratio for dentine hypersensitivity calculated based on numbers of exposed and unexposed subjects in case and control group indicates increased chances of dentine hypersensitivity in people who consume *Amlarasa* in excess amount. The 95% CI of odds ratio (0.97-3.93) indicates that odds of dentine hypersensitivity cases are not significantly higher for *Amlarasa Atisevana* (excess intake of sour taste) group at 95% significance level because the CI contains 1 numeral. Odds ratio (2.45) for stomatitis for the exposed group compared with unexposed group indicates moderate positive association between exposure (excess sour taste) and outcome (stomatitis). CI (1.12-5.40) at 95% level also indicates result is statistically significant because it's not containing 1. For halitosis, odds ratio estimate the relative risk for this symptom in relation to risk factor excess intake of sour taste is 2.76 times compare to normal intake of it but data not significant up to 0.05 level because CI value (0.96-7.98) contain 1. There was moderate association between heartburn and sour taste. Estimate relative risk for the symptom in relation to excess intake of sour taste is 2.21 and 1.09-4.53 CI indicates the significant result. 0.86 odds ratio and 0.32-2.32 CI at 0.05 level for urticaria indicate no significant association between excessive intake of sour taste and urticaria. The odds ratio for papules is 2.28 indicating increased odds of papules in people who consume *Amlarasa* in excess amount. The 95% CI of odds ratio (1.02-5.05) indicates that odds of papules cases are significantly higher for *Amlarasa Atisevana* (excess intake of sour taste) group at 0.05 significance level. Thus, result shows moderate association between papules and risk factor- excessive intake of *Amlarasa*. A strong association of joint inflammation with excessive intake of sour taste was observed (odds ratio-4.85). CI (1.09-10.24) at 0.05 level indicates that the result is statistically significant.

Discussion

Charaka samhita and other Ayurvedic classical texts mentioned physiological and pathological effect of *Rasa* (taste).[6-8] This documentation shows uniqueness of ancient literature. Classical texts also opine that the effect of particular *Rasa* is indirectly the effect of a *Dravya* which is the abode of that particular *Rasa*.[9] So here, effect of *Amlarasa Atiyoga* (excessive intake of sour taste) should be understood as *Atiyoga* of *Dravya* (item) having *Amlarasa* (excessive intake of food articles having sour taste).

Further, until date no study has been undertaken to evaluate the effect of excess use of *Amlarasa* predominant drugs/diets, on individuals, though classical texts have specifically mentioned *Atiyoga Lakshanas*. Few studies on preference of consumption habits in the general population have hinted the excess use of palatable tastes. *Amla* being a highly palatable taste the chances of over consumption are expected to be high. Keeping this

Table 2: Distribution of cases and overuse of sour taste in aspect of age and sex

Age and sex groups	Total subjects with overuse	Positive cases of overuse	Subjects with balanced use	Positive cases with balanced use	OR	CI
Age						
15-30 (young)	44	30	61	28	1.48	0.78-2.83
30-45 (middle)	18	12	28	12	1.56	0.57-4.21
45-60 (old)	9	8	18	8	2	0.56-7.1
Sex						
Male	37	25	52	20	1.75	0.85-3.62
Female	34	22	55	25	1.42	0.7-2.9

OR: Odds ratio, CI: Confidence interval

Table 3: Distribution of cases and controls for individual symptoms; and estimate of OR

Symptoms	Groups	Exposed	Unexposed	OR	CI (95%)
Dentine hypersensitivity	Cases	22	20	1.95	0.97-3.93
	Controls	49	87		
Stomatitis	Cases	18	13	2.45	1.12-5.40
	Controls	53	94		
Halitosis	Cases	10	6	2.76	0.96-7.98
	Controls	61	101		
Heartburn	Cases	22	18	2.21	1.09-4.53
	Controls	49	89		
Urticaria	Cases	7	12	0.86	0.32-2.32
	Controls	64	95		
Papules	Cases	17	13	2.28	1.02-5.05
	Controls	54	94		
Joint inflammation	Cases	18	7	4.85	1.09-10.24
	Controls	53	100		

OR: Odds ratio, CI: Confidence interval

hypothesis in mind a survey study was planned wherein the preferential food habits symptoms produced by it were elicited on the selected volunteers.

No specific quantification methods was available for the measurement of *Atiyoga* of *Rasa* in Ayurvedic classical texts, but the term *Atiyoga* (excess intake of sour taste) can be taken in two ways, i.e. in high quantity and/or in longer duration. In the present study, the concept of *Atiyoga* was considered as higher dose for longer duration and based upon that consumption of each sour food article routinely used was measured. Routine sour food article uptake pattern of many people was inquired and after that normal and excessive use of it was determined. Further it was discussed with faculty of the institute and then finalized.

Case-control studies can particularly be susceptible to certain types of biases as well as confounding and it is important to consider these potential limitations and make accommodations where possible to minimize them through proper population selection and survey design.[10] One potential type of bias is selection bias. When selecting a study population, controls should be representative of the cases. Controls should also be representative of the general population in terms of their probability of exposure. If the controls are artificially more like the cases, then results will underestimate the true odds ratio. If the controls are artificially less like the cases, then resulting odds ratio will be overestimated. Recall bias is a common concern for case-control studies which utilize surveys to collect study data. Cases and controls may remember or report their exposures differently. There is a tendency for cases to over-report exposures relative to controls. If cases systematically recall exposures more extensively than controls, the study results will be biases away from the null hypothesis and the effect of exposure may be overestimated.[10] To minimize the selection bias neighborhood controls were selected.

22 (31%) participants who reported dentinal sensitivity ingest more sour taste food articles like soft drink and citrus fruit regularly. Although, the habitual ingestion of soft drinks, which are mostly carbonated causes tooth wear by erosion of enamel and dentine leading subsequently to dentinal sensitivity. The citric acid in citrus fruits dissolves enamel and habitual ingestion of acidic substances causes erosion of enamel and dentin, subsequently opening dentinal tubules.[11-12] Hence it suggests that the *Amlarasa* is one of the main associates with dentine hypersensitivity.

Research shows that the exact cause of many aphthous ulcers is unknown but the factors that provoke them includes citrus fruits, physical trauma, lack of sleep, sudden weight loss, food allergies and immune system reactions.[13] However, sour taste of citrus fruits may associated with stomatitis but pathology of it is not established till date.

Heart burn may be a harmless transient phenomenon as well as a manifestation of gastroesophageal reflux disease. Citrus fruits and fruit juices may exacerbate symptoms; though the mechanism by which they cause heartburn is not clear.[14]

The inefficient metabolism of some individuals converts fruit acids (sour tasted) partly into energy; the rest forms lactic acid. Acids liberate histamine, which in turn causes swellings and strong inflammatory reactions. Therefore, inflammatory conditions deteriorate if fruit acids or acid-forming foods are ingested. Such inflammations are aggravated by insufficiently metabolized fruit acids, such as citric acid.[15] Hence, joint inflammation may be increased by *Amlarasa Drayas* containing acids.

Conclusion

Study reveals that *Amlarasa* could be a risk factor for joint inflammation, dentine hypersensitivity, stomatitis, halitosis, heartburn and papules. Study revalidates the consequences mentioned in Ayurvedic classical text regarding *Atiyoga* of *Amlarasa Sevana*. Positive association between such symptoms and age indicates that reduction of tolerability of sour taste as age progress. Further study should be conducted to identify the effect of seasonal and location variation on the relation between overuse of *Amlarasa* with such symptoms.

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हिन्दी सारांश

अम्लरस के अति–सेवन जन्य लक्षणों में सम्बन्ध–एक अध्ययन

कल्पेश बी. पनारा, रबिनारायण आचार्य

आहार चयन मे रुचि प्रधान कारण है । अम्लरस एक महत्त्वपूर्ण रस है, जो व्यक्ति को हमेशा आकर्षित करता है । आयुर्वेदीय ग्रंथो के अनुसार अम्लरस प्रधान आहार का सम्यक प्रमाण मे सेवन स्वास्थ्य को बनाये रखने में मदद करता हैं, परंतु अतिमात्रा मे यह दंतहर्ष, मुखपाक, मुखनासा–दुर्गंध, उरोदाह, शीत–पित्त, पिडीका, सन्धि–शोथ जैसे लक्षणों को जन्म देता है । इस बात को ध्यान में रखते हुए अम्ल रस प्रधान आहार के अति–सेवन तथा उससे उत्पन्न लक्षणों के मध्य में सम्बंध पर केस–कंट्रोल अध्ययन किया गया । कुल १७८ प्रतिभागियों का साक्षात्कार किया गया । माहिति संकलित करने के लिये विशिष्ट निदानपत्रक तैयार किया गया । परिणाम मे देखा गया कि दंतहर्ष, मुखपाक, मुखनासा–दुर्गंध, उरोदाह, पिडिका, सन्धि–शोथ लक्षणों के लिये अम्लरस निदानरुप कारक है । अध्ययन का परिणाम आयुर्वेदीय ग्रंथो में वर्णित 'अम्लरस अतियोग' सिद्धांत को प्रमाणित करता है ।