Hygeia.J.D.Med. November 2016 – May 2017 ISSN 2229 3590
Hygeia :: journal for drugs and medicines
November 2016
Open Access www.hygeiajournal.com
Research article section: Traditional Medicine
A Half Yearly Scientific, International, Open Access Journal for Drugs and Medicines
DOI:10.15254/H.J.D.Med.8.2016.157 Research Article

SOME THOUGHTS ON IMPROVING THE MANUFACTURING PROCESS OF AYURVEDIC *ARIṢṬA* AND *ĀSAVA*

Alex Thomas[1], Radha A[2], and D. Suresh Kumar[3]

Confederation for Ayurvedic Renaissance-Keralam Ltd, KINFRA Small Industries Park, Nalukettu Road, KINFRA Park P.O. 680 309, Koratty, Thrissur District, Kerala, India.

Present address:

1. International Institute of Biotechnology and Toxicology, Padappai- 601 301, Kanchipuram District, Tamil Nadu, India.
2. T.M.V. Aromatics Pvt Ltd, Plot No: 66 C, Industrial Development Plot, Kalamassery, Kochi – 682 109, Kerala, India.
3. Cymbio Pharma Pvt Ltd, 151, Industrial Suburb, Opposite to Metro Cash-and-Carry, Yeswanthpur, Bangalore- 560 022, India.

Keywords: Arişţa, Āsava, Fermentation, Brewing, *Woodfordia fruticosa*, yeast

Correspondence
D. Suresh Kumar Ph.D.
Cymbio Pharma Pvt Ltd
Opposite to Metro Cash-and-Carry
No.151, Industrial Suburb
Yeswanthpur, Bangalore – 560 022, India
Mobile: 094- 493-48897

Received: 12 August 2016,
Revised: 30 August 2016
Accepted: 30 September 2016,
Available online: 30 November 2016

ABSTRACT

***Plan**: To suggest some guidelines for improving the manufacture of ayurvedic āsava and arişţa so that they conform to the specification set by Government of India.*

***Prologue**: Ayurveda employs several classes of medicine in the treatment of diseases. Spirituous liquors (āsava, arişţa) form an important one among them. Nearly sixty such fermented medicines are used in contemporary Ayurvedic practice. Āsava and arişţa are traditionally prepared by mixing the decoction or juices with jaggery or honey, powders of specific herbs and flowers of Woodfordia fruticosa. It is believed that flowers of W. fruticosa are the source of the inoculum. The analytical laboratory of CARe Keralam Ltd has been estimating the alcohol content of commercial samples of āsava, arişţa since 2012. A look at the results of more than 500 samples analyzed here reveals interesting information. According to Ayurvedic pharmacopoeia of India āsava and arişţa should contain not less than 5% and not more than 11% alcohol. However, in reality commercially manufactured āsava and arişţa have varying content of alcohol, many of them not conforming to the specifications set by Government of India.*

***Outcome:** This problem can be solved by adopting fermentation method employed in the modern brewery science. Paying closer attention to factors like insoluble solids, available nitrogen, acid level, yeast and temperature control can improve the quality of the āsava and arişţa.*

1. INTRODUCTION

Ayurveda employs several classes of medicine in the treatment of diseases. According to the medieval work *Śārṅgadhara Samhita*, considered to be the authoritative work on ayurvedic pharmacy, expressed juices (*svarasa*), decoctions (*kāvtha*), spirituous liquors (*āsava*, *arişţa*), oils (*taila*), clarified butters (*ghṛtam*), electuaries (*lēhyam*), pastes (*kalka*), powders (*cūrna*) and tablets (*gulika*) are the important classes of medicines[1].

Corresponding author email: dvenu21@yahoo.com , Phone: +91 9449348897

Hygeia journal for drugs and medicines, 2229 3590,
Rid: D-2044-2014

Spirituous liquors prepared from fresh juices of herbs or fruits are called *āsava* and those prepared from decoctions of herbs are called *ariṣṭa*. Nearly sixty such fermented medicines are used in contemporary Ayurveda [2]. In addition to these, mention is also made in ayurvedic texts to many fermented products like *sura, madira, sidhu* etc. Ray (1980) lists twenty-six fermented products mentioned in *Caraka Saṃhita*[3]. Traditionally *āsava* and *ariṣṭa* are prepared by mixing the decoction/juices with jaggery or honey, powders of specific herbs and flowers of *Dhātakipuṣpa* or *Woodfordia fruticosa*. It is believed that flowers of *Woodfordia fruticosa* are the source of the inoculum. The impact of *Woodfordia fruticosa* flowers on the alcohol and sugar contents of *Nimbāriṣta* was investigated Kroes et al (1993) [4]. It was found that the flowers themselves are not the source of alcohol-producing microorganisms. An invertase activity exhibited by *Woodfordia* flowers may be responsible for this effect. Though *Dhātakipuṣpa* is used in traditional ayurvedic pharmacy as the starter, there are several *āsava* or *ariṣṭa* which do not have *dhātakipuṣpa* in the recipes (Table 1).

Table 1: Some *āsava* and *ariṣṭa* that do not have *dhātakipuṣpa* as an ingredient (Vaidyan and Pillai, 2006)

Sl. No.	*Name of formulation*	*Source of inoculum*
1	*Ahiphenasavam*	*Madhuka* flowers
2	*Amrtaristam*	Source of inoculum unknown
3	*Bhrngarajasavam*	Source of inoculum unknown
4	*Dhatryaristam*	Source of inoculum unknown
5	*Draksaristam*	*Priyangu* flowers
6	*Duralabharistam*	*Priyangu* flowers
7	*Gandiraristam*	Whey
8	*Gandirasavam*	Source of inoculum unknown
9	*Karpurasavam*	Source of inoculum unknown
10	*Lohasavam*	Source of inoculum unknown
11	*Madhukasavam*	*Madhuka* flowers
12	*Sirisaristam*	*Priyangu* flowers
13	*Triphalaristam*	Source of inoculum unknown
14	*Vasaristam*	Source of inoculum unknown

Flowers of *priyaṅgu* (*Aglaia roxburghiana*) or *madhuka* (*Madhuca longifolia*) are in the recipes of a few formulations. It is possible that these flowers harbour microorganisms that can ferment sugar into alcohol. As the recipes of some formulations do not contain sources of inoculum (Table 1), it is not clear how fermentation can be initiated in these cases.

2. Observations in CARe Keralam Ltd

The analytical laboratory of CARe Keralam Ltd has been estimating the alcohol content of commercial samples of *āsava* and *ariṣṭa* since 2012. Alcohol content of these samples are routinely determined according to Latimer Jr. (2012) [5]. 25 ml of the *āsava* or ariṣṭa is diluted with 150 ml of distilled water. The mixture is distilled and 90 ml of distillate is collected. The distillate is made up to 100 ml at 24.9 to 25.1^{o}C. The specific gravity of the diluted distillate is determined and the corresponding value for alcohol obtained from the reference table. A look at the results of more than 500 samples analyzed here reveals interesting information (Table 2). Graphical representation of the data is provided in Figure 1.

Table 2: Percentage of alcohol in commercial samples of *āsava* and *ariṣṭa**

2.00	2.50	2.92						
3.00	3.05	3.23						
4.02	4.42	4.82						
5.00	5.20	5.36	5.60	5.88				
5.00	5.20	5.36	5.60	5.88				
6.00	6.10		6.20	6.22	6.25	6.40	6.58	6.96
7.20	7.24		7.25	7.48	7.60	7.62	7.76	
8.00	8.14		8.18	8.40	8.84	8.99		
9.00	9.10		9.12	9.32	9.40	9.50	9.80	
10.00	10.24		10.40	10.80				
11.08	11.60		11.68	11.88				
12.00	12.42		12.80	12.88				

** Values in shaded areas conform to the pharmacopoeia range of alcohol*

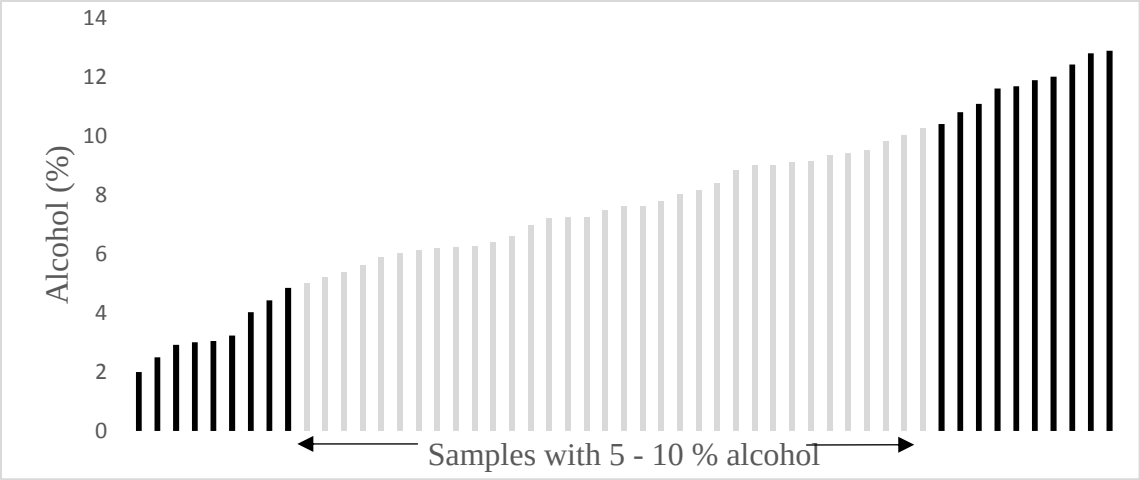

Figure 1: Graphical representation of alcohol content of commercial samples of *āsava* and *ariṣṭa*

According to Ayurvedic pharmacopoeia of India āsava and *ariṣṭa* should contain not less than 5% and not more than 11% alcohol [6]. However, in reality commercially manufactured *āsava* and *arista* have varying content of alcohol, many of them not conforming to the specifications set by Government of India. This problem can be solved by adopting fermentation method employed in brewing of wine.

3. Key factors influencing fermentation

3.1. Insoluble solids

The key factors influencing a good fermentation include insoluble solids, available nitrogen, acid level, proper strain of yeast and temperature control [7]. Insoluble solids consist of small particles of cellulose, hemicellulose, mineral salts, lipids, insoluble proteins and pectin, when fruits are used. Insoluble solids in the fermenting medium encourage elimination of carbon dioxide during fermentation, stimulate the multiplication of yeast, absorb toxic fatty acids that reduce the rate of fermentation, supply yeast nutrients and absorb some metabolic inhibitors [8].

3.2. Available nitrogen

Nitrogen is an essential nutrient for *Saccharomyces cerevisiae* yeast during fermentation. Ammonia, ammonium and amino acids are the major sources of nitrogen for the yeast. The three prime sources of nitrogen are glutamate, glutamine, and ammonia. The yeasts use these three primary nitrogen sources first. When the nitrogen is consumed completely, the yeast begins to feed on other amino acids. Aspartic acid, alanine, and arginine are the amino acids that are utilized by the yeast [7].

Too much ammonia increases the amount of amino acids in the finished product, modifying the aroma of the product. It can also initiate the development of ethyl carbamate, which is a carcinogen [7].

3.3. Acid level

The best pH range for fermentation is slightly below pH 3.6. Therefore, the acidity of the must needs to be adjusted. The most common acid used for increasing the acidity of the fermentation medium is tartaric acid. Tartaric acid has the greatest effect on lowering pH with a lesser increase in total acidity. Cation exchange is used in some countries to reduce the pH. Gypsum (calcium sulfate) will reduce the pH without affecting the titratable acidity. But much more gypsum must be used than with a tartaric acid addition. Additions of calcium carbonate, potassium bicarbonate, amelioration, neutral potassium tartrate, and double salt precipitation can be used to reduce the acid content [7].

3.4. Yeast

Yeasts are classified as a fungus. Because of their life cycle and the by-products from that life cycle, they are used in the food and beverage industries to create certain positive effects when introduced into various food media. Yeasts are used in brewery industry. Many varieties of yeasts occur in nature. The cultured yeast most often used for alcohol conversion in grape juice is *Saccharomyces cerevisiae*, which is one of the seven wine-related species from the genus *Saccharomyces. Saccharomyces cerevisiae* has been isolated and cultured further by their ability to tolerate alcohol, temperature, pH, and SO_2. Pasteur-Champagne, Pasteur-Red, Eperny, Montrachet, Prise-de-mousse, Tokay, Steinberger, and California-Champagne are the sub-categories used in brewing of wine [7].

Only a portion of the energy created by catabolism of yeast is used by the organism. The rest is dissipated as heat. Ethanol is a by-product of glycolysis that is directly followed by alcoholic fermentation. Alcoholic fermentation begins as glycolysis ends, breaking down the pyruvate into acetaldehyde and CO_2, and ethanol through enzymatic activity. The heat generated from excess energy not used for cellular metabolism is a matter of great concern during fermentation. Vigorous fermentations produce a large amount of heat, raising the temperature of the fermenting medium to the extent that it can kill the yeast and halt fermentation. Temperature control of fermentation is necessary to protect the yeast and control the rate of the fermentation [7].

3.5. Temperature control

For a long time, difficult final stages of fermentation and stuck (sluggish) fermentations were problems during red winemaking. Temperature control systems and the general practice of pumping-over with aeration limited these incidents. The monitoring of tank temperature daily during fermentation is, therefore indispensable. However, this measurement must be taken properly. The temperature of the fermentation medium can be taken with a dial thermometer having a 1.5 m probe. The temperature can also be taken by thermoelectric probes judiciously placed in each tank. The probes are linked to a measurement system in the laboratory. With this system, the brewer can verify the temperature of the tanks at any moment. Certain temperature control systems automatically regulate tank temperature when the temperature reaches certain value [8].

Stainless steel tanks have the significant advantage of being hermetic and easily fitted with various types of equipment. Their internal and external maintenance is also facilitated. Their inner walls are impregnable. Stainless steel also has a good thermal exchange, avoiding excessive temperature increases. In any case, cooling is simplified. A cool liquid is circulated within the double wall of the tank or in an integrated thermal exchanger. When a sufficient amount of cool water is available, running water over the exterior of the tank can be sufficient. The introduction of stainless steel tanks in the 1960s and 1970s represented a considerable advance in temperature control compared to wooden and concrete tanks [8].

3.6. Proposed Fermentation of Ariṣṭa and Āsava

To maintain high quality of the *ariṣṭa* or *āsava,* all the ingredients used in their production should be subjected to chemical and microbiological analysis. Only those that conform to the specification should be taken up for production. Only deionized water should be used for fermentation. Instead of wooden vats, it is better to use stainless steel fermentation tanks. The fermentation tank should be housed in an aseptic, closed room maintained at a temperature of 25-30^{o}C and a relative humidity of 40-45%.

The decoction of herbs or juices of herbs or fruits are to be prepared as instructed in the Sanskrit source of the formula. The specific gravity of the decoction or juice should be determined. Jaggery or honey are to be added to the decoction or juice. Specific gravity of water is 1 and when herbs are boiled in water, the resultant *kvātha* will have a slightly higher specific gravity. For example, *Vara Asanādi kvātha* has a specific gravity of 1.0185 [9]. When sugar is added to this *kvātha*, the specific gravity of the *kvātha* will increase by factor Y.

Then specific gravity of the *kvātha* will be X + Y, where X is the specific gravity of *kvātha.* Required range of specific gravity in respect to water, to yield 5-11 % alcohol is 1 + 0.0388 (Ya) to 1 + 0.0799 (Yb). So increase in specific gravity is needed to get desired percentage of alcohol = (X+Ya) to (X+ Yb). An increase in 0.1° Brix increases specific gravity by 0.0004 and alcohol yield by 0.1%.

Degrees Brix is the content of sugar in an aqueous solution of sugar. 1 g of sucrose dissolved in 100 g of water yields one degree Brix. Brix value is determined using a hydrometer or refractometer [10].

Following the Brix determination, the acidity of the fermentation medium is to be checked and adjusted to the desired value, as described above. As fermentation is to begin, baseline analysis for reducing sugar, titratable acidity, pH, acetic acid and volatile acidity is to be conducted. This will help to track the progress of fermentation [7].

Dried Activated Yeast (DAY) is used to cause fermentation of the medium. DAY is added to warm water (35-40^{O}C), suspended well and added to the fermentation medium. A dose of 10-20 g of DAY/100 litres is generally recommended [8]. The fermentation tank is left undisturbed for specified period of time.

Several methods are used to monitor the fermentation. Important among them is the counting of yeasts. After diluting the fermentation medium, the total number of yeast cells is counted under the microscope using a Malassez cell. The total cells enumerated in this way include both "dead" yeast and "live" yeast. The counting of "viable cells" is a better way to differentiate between the "dead" and "live" cells. When the diluted fermentation medium is placed in a solid nutritive medium, the viable yeast cells form a microscopic cluster. The number of viable yeast cells is enumerated by counting the colonies formed on this medium after nearly four days [8].

Rate of fermentation can also be tracked by estimating the amount of sugar consumed or the alcohol generated. As a relationship exists between the amount of alcohol generated and the initial concentration of sugar in the fermentation medium, the mass per unit volume (density) can give directly an approximate potential alcohol. The density and potential alcohol are usually marked on the stem of the hydrometer [8].

The monitoring of tank temperature daily during fermentation is indispensable to keeping a tab on fermentation. The tank temperatures are different in different areas of the tank. The temperature is highest in the cap and lowest at the bottom of the tank. The temperature is usually taken after a pumping-over, which agitates the fermenting medium and homogenizes the tank temperature. Average tank temperature can be measured in this way [8].

Cessation of fermentation is confirmed by exact analysis of residual reducing sugar. Volatile acidity, acetic acid, titratable acidity and pH are measured. In addition to these tests, the *ariṣṭa* or *āsava* may be tested for the following parameters like specific gravity at 20°C, total solids, alcohol content, methanol content, non- reducing sugar, TLC/HPTLC identification, heavy metals, microbial contamination, specific pathogens and pesticide residues [11]. A flowchart of the proposed brewing of *āsava* and *ariṣṭa* according to principles of modern brewery technology is presented in Figure 2.

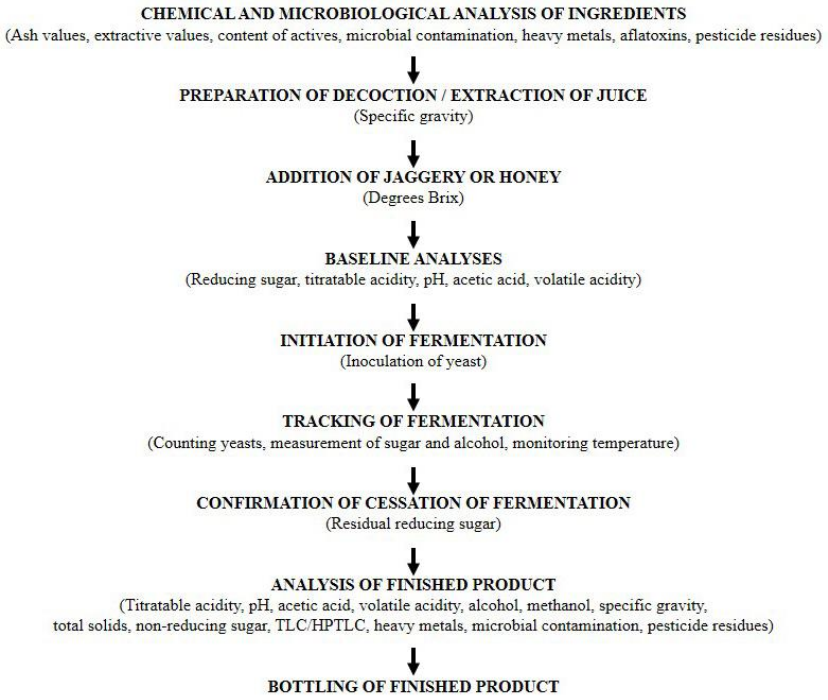

Figure 2. Flowchart for the proposed brewing of *āsava* and *ariṣṭa*

4. CONCLUSION

Ariṣṭa and *āsava* manufactured in the traditional way differ in their content of alcohol. Products having less than 5 % alcohol are unstable and prone to degradation. This problem can be circumvented by adopting modern techniques of fermentation. The technology of fermentation of *ariṣṭa* and *āsava* is therefore, to be modified considering the advances made in fermentation technology and brewery science. It is hoped that the guidelines proposed in this paper will initiate debate on this subject.

ACKNOWLEDGEMENT

The authors are grateful to the management of CARe Keralam Ltd for providing facilities and encouraging us to do this work.

Conflicts of interest

The authors have no conflicts of interests.

REFERENCES

1. Murthy KRS (Ed.), *Śārṅgadhara Samhita* (Chowkhamba Orientalia, Varanasi) 1984, pp. 45.
2. Vaidyan KVK & Pillai ASG, *Sahasrayōgam* (Vidyarambham Publishers, Mullackal, Alleppey, Kerala) 2006, pp. 236-268.
3. Ray P, *Caraka Samhita* -A Scientific Synopsis (Indian National Science Academy, New Delhi) 1980, p. 90.
4. Kroes AJJ, Abeysekera AM, de Silva KTD & Labadie RP, Fermentation in traditional medicine: the impact of *Woodfordia fruticosa* flowers on the immunomodulatory activity, and the alcohol and sugar contents of *Nimba arishta*. *J Ethnopharmacol*, 40 (1993) 117-125. CrossRef
5. Latimer Jr. G W, *Official methods of analysis of AOAC International*, 19th edn, (AOAC international, Maryland, U.S.A.) 2012, Chapter 27, p.4.
6. Anonymous, *Ayurvedic Pharmacopoeia India* (Controller of Publications, Department of Ayush) 1996, Volume 2, p. 87.
7. Jacobson J L, Introduction *to wine laboratory practices and procedures* (Springer Science + Business Media, Inc., New York) 2006, p.p. 1-375.
8. Ribereau-Gayon P, Dubourdieu D, Doneche B & Lonvaud A ,*Handbook of Enology* (John Wiley & Sons, Chichester, UK) 2000, Volume 1: The Microbiology of Wine and Vinifications (J. Branco Jr., transl.), 1-497.
9. Ramachandra AP, Prasad SM, Samarakoon S MS, Chandola HM, Harisha CR & Shukla VJ, Pharmacognostical and phytochemical evaluation of *Vara Asanadi Kwatha*. *AYU* 33 (2012) 130-135. CrossRef , PMid: 23049198 PMCid: PMC3456851
10. Morrison-Low AD, Hydrometer, In: Instruments of Science- An historical encyclopedia, (Bud R, Warner DJ), 1998, 311-313.
11. Lohar DR, *Protocol For Testing Ayurvedic, Siddha & Unani Medicines* (Government of India, Department of AYUSH, Ministry of Health & Family Welfare, Pharmacopoeial Laboratory For Indian Medicines Ghaziabad) 2011, pp. 1-200.

Alex Thomas, Radha A, and D. Suresh Kumar. Some thoughts on improving the manufacturing process of ayurvedic *arişţa* and *āsava* . Hygeia.J.D.Med. 2016; 8 (2):11-18. Available from http://www.hygeiajournal.com / Article ID-Hygeia.J.D.Med/157/16. DOI 10.15254/H.J.D.Med.8.2016.157.