

Habitual Herbal Water Recipes to hold back Waterborne Contagious Diseases

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Abstract

Background: Water - the elixir of life is also being a medium to spread many communicable diseases. The scarcity and lack of safe drinking water have been the cause for high prevalence of death rate than war or terrorism in the world. **Objective:** The study reviews effects of water pollution, usage and ailing effects of plastics in provision of safe drinking water at hospitality sector and gives alternative and initiative suggestions to overcome those environmental crises by formulating natural and traditional methods of water treatment to serve healthy herbal water. **Method:** Natural ayurvedic ingredients apt for treating water are explored, a systematic method of water treatment is formulated with the identified ingredients. The water is served to 30 panelist members with no regard to their age or gender. The opinion about their preference towards the organoleptic quality of the served water is recorded. The test is done with water from various part of the city. **Result:** Water samples being served have a good score of acceptance among the panel list members Nannari water (Sample 1) has the prime acceptance than other samples. **Conclusion:** The study exposes treating water with these natural ingredients inhibits infectious organism present in water and improves the micronutrients and nutritional value of drinking water. Besides promoting the human health it also reduces the usage of plastics and sustains the environmental wellness.

Keywords: Drinking Water, Plastic Bottles, Tradition, Ingredient

INTRODUCTION

Water is an indispensable source of Mother Nature that protracts the life of earth. It is primarily required for drinking and other life developmental activities hence it is a fundamental need for all living creatures to have a safe and harmless drinking water.¹ The main pollutants of drinking water are the germs and chemicals from various sources like residential drainages, industries, agricultural processes etc.² Innumerable diseases are caused due to the consumption of polluted water globally about 3.1 percentage of death are caused due water borne diseases.³

There is a greater association between pollution and health problem. Disease causing microorganisms are known as pathogens and these pathogens are spreading disease directly among humans. Some pathogens are worldwide some are found in well-defined area. Health risk associated with polluted water includes different diseases such as respiratory disease, cancer, diarrheal disease, neurological disorder and cardiovascular disease.

Water pollution is a global issue and world community is facing worst results of polluted water. Major sources of water pollution are discharge of domestic and agriculture wastes, population growth, excessive

use of pesticides and fertilizers and urbanization. Bacterial, viral and parasitic diseases are spreading through polluted water and affecting human health. The need for safe drinking water, fundamental need for a human being has elevated the sales of packaged waters being treated with chemicals. This creates an environmental crisis by generating about a million of plastic bottles per minute that will be raised by 20% in 2021.⁴

The hospitality sectors are the prime users of these water bottles to gain good will among the guest, providing safe drinking water. Among the wastages from hotels 11.2% are plastic wastages which even rise to 20.1% during the festival events in which these plastic bottles constitutes the major part. Beside the star hotels nowadays small restaurants and other food catering units have started using these water bottles producing about tones of plastic wastages every second.⁵ These plastic bottles were being dumped in oceans and landfills creating a massive environmental problem to the planet.

Refusing is one of the easiest methods to trim down the plastic usage than reuse or reduce. Purchases is directly proportional to waste yielded in hotels, thus refusing the usage of these plastic minimizes these wastages that also helps the concerns spending in disposal of these solid waste.⁶ Refusing the usage of plastic water bottles reduces the cost of purchase, waste disposal, energy and also conserves natural resources.⁷ Usage of these water bottles in hotels can be avoided by providing a safe and healthy drinking water being treated with natural and healthy traditional ayurvedic ingredients.

Boiling the water at a boiling point about 212 degree Fahrenheit kills almost all bacteria or micro - organisms present in it. This simple method of water treatment is used in the study, adding the natural ayurvedic ingredients to the water.⁸ This method of water purification have been still followed in rural areas. Many natural ingredients used as ayurvedic and sidha medicines were used in water treatment to make it herbal, healthy and natural body coolant.

Thus, the study engross to exhibit the personal opinions of the employees at accommodation operation department in hotel industry with regard to usage of plastic drinking water bottles, guest opinion about the herbal water usage in hotel industry as an alternative for bottled drinking water and the herbal quality of the water treated with ayurvedic ingredients

MATERIALS AND METHODS

The study was initiated in identification of wastages from the hotel industry and the personal opinion of the guest staying in hotels regarding their preference in consumption of ayurvedic herbal waters as an alternative to packaged drinking water. Two set of questionnaires were prepared and used as a tool for the survey. The one compiled for the employees at accommodation operation department constitutes questions to bring out the opinion of the employees in handling the plastic water bottle wastages and their difficulties in disposal of such wastages. The other questionnaire for the guest was carefully compiled to check the personal opinion of the guest staying in hotels with no regards to their nationality, age or gender. The questions were framed to exhibit their opinion in consuming the herbal drinking water as an alternative to bottled drinking water.

Exploration of Ingredients:

The main aim of the study was identifying the ayurvedic or sidha ingredients being traditionally used in the treatment for water. Ingredients were examined through primary survey among the practices of ayurvedic and sidha therapist, shops stores involved in handlings these herbs and medicines in and around the Chennai city and also among the people from the rural parts of Tamil Nadu. A variety of ingredients has been used in the treatment of water to improve its herbal quality and reduce the microorganism present in it. Secondary data from the sources of literature in books, magazines and internet sources are explored to bring out the medicinal values and health benefits of the ingredients. An exploration for the natural ingredients the following medicinal herbs being used in sidha and ayurvedic treatments were used for the study.

Nannari (Hemidesmusindicus) is a common herb being used in water purification for ages. The root and bark part of the plant is used for water purification it constitutes various medicinal benefits that cures indigestion, loss of appetite, skin diseases, Diarrhea etc⁹.

Vetiver (Chrysopogonizanioides) is a perennial grass belonging to poaceae family¹⁰ is widely grown in tropical countries used in natural water treatment for water resources¹¹. Vetiver is a good source of antioxidative constituent that reduces mental stress¹² and its cooling attribute soothes the inflammation of internal organs.¹³ Consumption of vetiver treated water reduces intestinal infections and urinal infections.¹⁴

Karunkali (Acacia catechu (L.F.) WILD) is a deciduous tree¹⁵ with reddish hue, the bark, resin, root part of the tree are medically rich. These trees are planted in many temples in south India especially Tamil Nadu for their effective property in killing infectious microorganisms. The bark and heart wood of the tree possess anti-bacterial, anti diarrhoeal, and anticancer properties that helps in protecting human from may microorganisms¹⁶. The water consumed with karunkali bark treats sore throats, heals internal wounds¹⁷

Pathimugam (Caesalpiniasappan) this belongs to flowering Leguminosae family used worldwide for its medicinal properties.¹⁸ Many researchers have confirmed it as an antiviral, antimicrobial. Pathimugam is being used in ayurvedic medicines for its prophylactic properties. In olden days containers have been made out of this wood to store water.¹⁹ The water treated with pathimugam quenches thirst cures kidney disorder, purifies blood, treats piles, heart diseases, etc.²⁰

Procurement of Ingredients:

The ingredients used are procured from the ayurvedic and sidha shops in and around Chennai the ingredients are checked for their originality. Procured ingredients are stored in ample room temperature for the further use. The water samples used in the study are ground water collected from various part of the Chennai city namely Ramapuram, Pallavaram, Velachery and Besant Nagar for a reliable result.

Mise en place Preparation:

As per the need for the study the ingredients were prepared for the study. All ingredients were cleaned washed and shadow dried at room temperature. The roots Vettiver and Nannari and the bark Karunkali and Pathimugam are crushed and kept aside.

Methods of Preparation and coding samples

Boiling of water is the common method of water treatment to kill micro organism present in it. This method is used for the study adding the ayurvedic ingredients with water.

- A copper vessel with one litre of water is boiled.
- Add 5g – 10 g of the ayurvedic ingredient is added to the water.
- Water is boiled and simmered for five minutes after adding the ingredient.
- Finally the water is strained and stored in another copper container.
- Serve the water warm.

Coding of Water samples:

The water samples are coded upon the addition of ayurvedic ingredients used in the treatment and the water source area (Table 1). The experiment is done with water from different part of the city namely Ramapuram(R), Pallavaram(P), Velechery(V) and Besant Nagar(B).

Table 1 : Coding of Water Sampses

S.No	Ingredients	Ramapuram(R)	Pallavaram(P)	Velachery(V)	Besant Nagar(B)
1	Nannari Root (N)	NR1	NP1	NV1	NB1
2	Vettiver Root (V)	VR2	VP2	VV2	VB2
3	Karunkali Bark(K)	KR3	KP3	KV3	KB3
4	Pathimugam(P)	PR4	PP4	PV4	PB4

Sensory Evaluation:

Sensory evaluation for the prepared water samples were carried out to estimate the panelist evaluation for the organoleptic attributes such as the aroma, color, taste, freshness and overall acceptance. A five point hedonic scale (Table 2) was used in the test with the score ranging from Like Very Much (5), Like (4), Neither Like Nor Dislike(3), Dislike(2) and Dislike Very Much (1). The samples were served among 30 panelists (Male: 19 and Female: 11). The samples were randomly served among the panelist in an adequate interval of time and a small briefing about the sample was explained to the panelist without disclosing the ingredients to avoid misinterpretation. The data were collected and were analyzed with SPSS software (21.0),

Table 2. Sensory evaluation Score Card:**HEDONIC SCORE CARD RATING****DATE:****PANELIST NAME:****SAMPLE CODE:**

Please taste the given coded water samples and mark (✓) how much you like or dislike it on the point in the scale which best describes your opinion

Sl. No	Hedonic Score	Organoleptic parameters			
		Aroma	Colour	Freshness	Acceptance
1	Dislike Very Much				
2	Dislike				
3	Neither Like Nor Dislike				
4	Like				
5	Like Very much				

Microbial Evaluation:

The samples of water were evaluated for its microbial quality. The water samples are checked for the microbial quality and analyzed for the presence of the total count of Salmonella, Staphylococcus, Aureus, Escherichia Coli, Yeast and Mold. The test was done at two states one when the water samples are freshly prepared and other after 12 hours of storage time at room temperature ($28.2^{\circ}\text{C} \pm 2.3^{\circ}\text{C}$).

pH value Testing:

The water samples were tested for the pH value using pH testing strips that contains a range of bars that changes colour being dipped in the solution. The pH values of the sample are checked using such strips, the samples are collected in a clean container and the strip is immersed into the sample. The colour of the bars at the strip changes with which the pH value is calculated comparing with the pH level chart. The samples of water are checked for the pH variation at the initial stage before treatment and after treatment with the ayurvedic ingredients.

RESULTS AND DISCUSSIONS:

The study was carried out in identifying appropriate ayurvedic or sidha ingredients used in water treatment, for reliable result water from different parts of the city. The water samples were coded upon the ingredients used and the source of area water. The study was carried out about three months of time during the months of October, November and December 2022 with ample time required to complete the sensory test for all the coded samples. The source of water may influence the organoleptic quality of the study herby the study was carried out several numbers of times to attain a reliable result though the procedure was quite long process.

Table 3. General Profile of Employees in Accommodation Operation Industry and Guests Residing in Hotels

Particulars	Percentage (n=191)
Profile of Employees in Accommodation Operation Industry	
Gender	
Male	73
Female	27
Work Experience	
>10 years	20
5 – 10 years	37
2 – 5 years	43
Profile of Guests residing in Hotels	
Particulars	Percentage (n=247)
Male	56
Female	44
Type of Guest	
Domestic	77
International	23

Table 3 presents data on the general profile of the employees in Accommodation operation industry. Majority of the employees (73%) were male and 27 % were female. Twenty per cent of the employees had a work experience of more than 10 years, 37 % had a work experience of 5 – 10 years and 43 per cent were working for about two to five years.

A survey was also conducted among guests staying in hotels for their opinion on using herbal water as an alternative to bottled drinking water. Among the guest, majority (56%) were male and 44% were female. Majority (77%) of the guests were domestic guest from other states of India and 23% were foreign guests from countries such as Sri Lanka, Malaysia, Singapore, Kenya, Britain and Philippines.

Employee’s Opinions on Waste Disposals

The data collected were fed into SPSS (24.0) software and was statistically analysed. The chi- square test was conducted to analyze the opinion of the employees that plastic water bottles acquire the foremost ratio among the plastic wastages, there was a significant association in their opinion with a chi square value of (132.43) significant at (0.05) level. The one way anova test was done to check the difference in waste disposal treatments according to the years of experience of the employees. The statistical analysis shows that there is significant difference in waste disposal practices among the employees according their years of experience with F value 3.138 and significant at (0.00) level. Thus the employees with more years of experience are familiar in segregation, reuse and disposals of these water bottles.

Guest opinion in acceptance of herbal water for bottled water:

The guest staying in the hotel were surveyed for the opinion about the usage of these formulated herbal drinking water as alter to bottled drinking water. Majority (75%) of the guest had a positive opinion in accepting herbal water as an alternative to chemically treated bottled water. The acceptance from the foreign guest is comparatively lesser than the domestic guest as they were not aware of the herbal ayurvedic ingredients being used in water treatments for ages in India.

One way anova test was conducted to check whether the nationality has a difference in opinion in acceptance of herbal drinking water, the analysis shows that nationality does not makes any significant difference in the acceptance level of herbal water with F value 28.3 and significant at (0.00) level of significance. Pearson correlation test was conducted to check the relationship between the facts that the provision of free water bottles at hotel increases the usage of these water bottles, the test shows that there exists a positive correlation between the variables with r value 0.439 significant at (0.05) level. It was evident that the hospitality industry must avoid the provision of free water bottles to the guest to reduce the consumption of these packaged water bottles.

Sensory Evaluation Report:

Table 4 : Mean Score of Sensory Evaluation of Water Samples

Sl. No	Organoleptic Quality	Freshly Prepared	After 12 Hours Storage
Aroma			
1	Nannari Root	4.67±0.24	4.02±0.93
2	Vettiver Root	4.37±0.07	3.17±0.12
3	Karunkali Bark	4.12±0.93	3.05±0.10
4	Pathimugam	4.22±0.31	3.03±0.27
Colour			
1	Nannari Root	4.47±0.07	3.01±0.93
2	Vettiver Root	4.23±0.33	3.02±0.93
3	Karunkali Bark	4.15±0.32	2.11±0.10
4	Pathimugam	4.63±0.31	3.17±0.12
Freshness			
1	Nannari Root	4.60±0.31	4.28±0.92
0	Vettiver Root	4.13±0.29	4.00±0.12
11	Karunkali Bark	4.02±0.93	3.75±0.27
12	Pathimugam	4.42±0.12	4.35±0.10
Overall Acceptance			
13	Nannari Root	4.53±0.18	4.03±0.11
14	Vettiver Root	4.02±0.31	3.01±0.29
15	Karunkali Bark	4.09±0.11	3.09±0.07
16	Pathimugam	4.17±0.12	3.97±0.12

The result of the sensory evaluation test is exhibited in table 4. The procedure followed in the evaluation is carried out as for example, the water from four areas of the study are treated with the ingredient Nannari (codes NR1, NP1, NV1, NB1) are served to the panelist and their opinion about their organoleptic qualities are collected and an average is calculated to exhibit their actual preference for the ingredient than the source area of water.

From Table 4, it is identified that the organoleptic preferences of water stored is slightly reduced when compared to freshly prepared water. Among the water samples, the water treated with Nannari has been more preferred for its aroma, freshness and overall acceptance. Pathimugam is accepted for its light natural pinkish colour. There exists not a much difference in the acceptance of water for their freshness being served freshly prepared or served after a storage time of 12 hours.

The Statistical Analysis was conducted with the sensory data. The analysis proves that there exists no significant difference in the freshness of the water treated with Nannari Ingredient during freshly prepared and after 12 hours storage with (r value =0.4352) significant at (0.02) level. There is no significant difference in the colour of waters treated with Pathimugam and Nannari at (0.05) level beside, the analysis says that there is a significant difference in their aroma and acceptance among the panelist at (0.05) level significance. The overall acceptance level of the water samples at the stages of freshly prepared and after 12 hours of storage have a satisfactory acceptance among the panelist members. Hence the water prepared can be stored for hours and can be served to the guest beside must be served warm for an effectual acceptance.

pH value analysis of Water Samples

Table 5. Means Score of pH Value of Water Samples

Sl.No	Water Samples	Freshly Prepared	After 12 Hours Storage
1	Nannari Root	6.53±0.01	6.96±0.21
2	Vettiver Root	6.57±0.14	6.65±0.70
3	Karunkali Bark	6.55±0.02	6.59±0.55
4	Pathimugam	6.75±0.02	6.91±0.1

The pH value of the water samples were calculated with the strips Table.5 indicates the mean score of the water samples treated with respective ingredients. The table exhibits there exist no change immense change in the pH value of the samples being freshly prepared or at the stage after 12 hours of storage. The actual pH value of pure drinking water lies between 6.5 to 8.5 whereas the bottled drinking water lies between 6.9 to 7.5 pH value.²¹Hereby in the study the value lies between 6.5 to 6.9 since being treated with ayurvedic ingredients. There is a slight projection in the pH value of water sample after 12 hours of storage which may be due to the development bacteria producing acidic or alkaline metabolic waste.²² The pH value may also differ according to the source area of water.

Conclusion

The nature has provided us with all natural antidotes for every problem altering those creates severe agony to our planet. Dumping of plastic wastages kills the planets natural affluence. Usage of plastic water bottles at hospitality industry can be widely reduced by returning to our ancestral methods of water treatment with natural ayurvedic ingredients. Thus the study explores and exhibits the natural ayurvedic ingredients used in water treatments it also recommends the hoteliers to practice these natural methods and create awareness among the guests about nutritional benefits of herbal water.

Limitation Of The Study

- Due to the time constraint, a larger sample size could not be covered for the study. The study may be more reliable with more water samples from different areas of water source.

Conflict Of Interest

Nil

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Ethical Clearance

Nil

References

1. MehtabHaseena, Muhammad Faheem Malik et.al, Water pollution and human health. Environmental Risk Assessment and Remediation Volume (1), Issue 3. Available from: [http://www.alliedacademies.org/articles/water-pollution-and-human-health-7925.html#5\(2017\)](http://www.alliedacademies.org/articles/water-pollution-and-human-health-7925.html#5(2017)).
2. Ahmed, Shahid and Ismail, Saba, Water Pollution and its Sources, Effects & Management: A Case Study of Delhi Shahid Ahmed and Saba Ismail 'Water Pollution and its Sources, Effects & Management: A Case Study of Delhi', International Journal of Current Advanced Research, 07(2), pp. 10436-10442. Available at SSRN: [https://ssrn.com/abstract=3145289\(2018\)](https://ssrn.com/abstract=3145289(2018)).
3. Pawari MJ, Gawande S. Ground water pollution & its consequence. International journal of engineering research and general science.;3(4):773-76(2015).
4. Sandra Laville and Matthew Taylor. A million bottles a minute: world's plastic binge 'as dangerous as climate change'. The Gaurdian.com [Internet]. Available from: [https://www.theguardian.com/environment/2017/jun/28/a-million-a-minute-worlds-plastic-bottle-binge-as-dangerous-as-climate-change\(2017\) June 28;January 23\(2019\)](https://www.theguardian.com/environment/2017/jun/28/a-million-a-minute-worlds-plastic-bottle-binge-as-dangerous-as-climate-change(2017) June 28;January 23(2019)).
5. Lucas LourençoCastiglioniGuidoni, Bianca Peruchinet. al., Solid Waste Generation in A Hotel Event Service. Rev. Int. Contam. Ambie. 34 (2) 237-247, DOI: 10.20937/RICA.2018.34.02.05 Available from: [https://pdfs.semanticscholar.org/c838/39d0a5bd6a76cb43328b0967570cd41d134a.pdf\(2018\)](https://pdfs.semanticscholar.org/c838/39d0a5bd6a76cb43328b0967570cd41d134a.pdf(2018)).

6. A. A. Zorpas , K. Lasaridi et.al., Solid waste from the hospitality industry in Cyprus. WIT Transactions on Ecology and The Environment, Vol 166, © www.witpress.com Press doi:10.2495/ISLANDS120041.Available from: <https://www.witpress.com/Secure/elibrary/papers/ISLANDS12/ISLANDS12004FU1.pdf>(2012).
7. Kumar, S., Smith, S. R., Fowler, G., Velis, C., Kumar, S. J., Arya, S., ...Cheeseman, C. Challenges and opportunities associated with waste management in India. Royal Society open science, 4(3), 160764. doi:10.1098/rsos.160764(2017).
8. S. SharmaA. & Bhattacharya. Drinking water contamination and treatment techniques. Volume(7), Issue 3, pp 1043–1067<https://doi.org/10.1007/s13201-016-0455-7>.(2017).
9. D. B. More, Pranita Mali. A review article on species used as sariva in different regions of india: hemidesmusindicus, ichnocrpusfrutescens, decalepishamiltoni and cryptolepisbuchanani. Ayurlog: National Journal of Research in Ayurved Science. Volume: 6th | Issue: 4th | June ISBN 978-93-5137-179-3 ISSN 2320-7329 Website: <http://www.ayurlog.com> (2018).
10. Burger, P., Landreau, A., Watson, M., Janci, L., Cassisa, V., Kempf, M., ... Fernandez, X. Vetiver Essential Oil in Cosmetics: What Is New?. Medicines (Basel, Switzerland), 4(2), 41. doi:10.3390/medicines4020041(2017).
11. NarongChomchalow. The Role of Vetiver in Controlling Water Quantity and Treating Water Quality: An Overview with Special Reference to Thailand. AU J.T. 6(3): 145-161
12. Cheaha, D., Issuriya, A., Manor, R., Kwangjai, J., Rujiralai, T., &Kumarnsit, E. Modification of sleep-waking and electroencephalogram induced by vetiver essential oil inhalation. Journal of intercultural ethnopharmacology, 5(1), 72–78. doi:10.5455/jice.20160208050736(2016).
13. D. Balasankar1 , K. Vanilarasu et.al., Traditional and Medicinal Uses of Vetiver. Journal of Medicinal Plants Studies Year Volume: 1, Issue: 3 First page: (191) Last page: (200) ISSN: 2320-3862 Online Available at www.plantsjournal.com. (2013).
14. Saresselva. 15 Health Benefits of Vetiver. Herbal Plant. [Internet] Cited on. Available form: <https://drhealthbenefits.com/herbal/herbal-plant/health-benefits-of-vetiver>August 28 (2017);June 5(2019).
15. K.N. Singh and BrijLal Notes on Traditional Uses of Khair (Acacia catechu Willd.) by Inhabitants of Shivalik Range in Western Himalaya. Ethnobotanical Leaflets 10: 109-112. Available from: <https://pdfs.semanticscholar.org/64d1/7f735c998868f0ba72da95018288d2aae1db.pdf>(2006).
16. 16.Saha, M. R., Dey, P., Begum, S., De, B., Chaudhuri, T. K., Sarker, D. D., ... Sen, A. Effect of Acacia catechu (L.f.) Willd. on Oxidative Stress with Possible Implications in Alleviating Selected Cognitive Disorders. PloS one, 11(3), e0150574. doi:10.1371/journal.pone.0150574(2016).
17. KhandekarSurekhaBabasahebet.al.,Phytopharmacology Of Acacia Catechu Willd: A Review. European Journal Of Pharmaceutical And Medical Research. ejpmr, 6(1), 216-223. Available from: https://www.ejpmr.com/admin/assets/article_issue/1546248225.pdf2019.
18. R. Murugeswaran, A. Rajendran, K. Venkatesan, Hafiz C. M. Aslam. Diversity of Unani Medicinal Plants in Southern Western Ghats of Coimbatore District, Tamil Nadu, India. International Journal of Herbal Medicine; 2 (1): 29-38(2014).
19. P. S. Harikumar and C. M. Manjush. Study on the antibacterial activity of selected natural herbs and their application in water treatment. Drink. Water Eng. Sci. Discuss., 6, 199–231, 2013 www.drink-water-eng-sci-discuss.net/6/199/2013/.(2013).

20. Mu'nisa, A., Muflihunna, A., &Hala, Y. ANTIOXIDANT ACTIVITY ASSAY OF SAPPAN WOOD (*Caesalpiniasappan* L.). In Proceeding International Conference on Mathematic, Science, Technology, Education and their Applications (Vol. 1, No. 1)(2016).
21. Kulthanan, K., Nuchkull, P., &Varothai, S. The pH of water from various sources: an overview for recommendation for patients with atopic dermatitis. *Asia Pacific allergy*, 3(3), 155–160. doi:10.5415/apallergy.2013.3.3.155.(2013).
22. Enyoh CE, Verla AW, Egejuru NJ pH Variations and Chemometric Assessment of Borehole Water in Orji, Owerri Imo State, Nigeria. *J Environ Anal Chem* 5: 238 DOI: [10.4172/2380-2391.1000238](https://doi.org/10.4172/2380-2391.1000238)(2018).