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SHORT COMMUNICATION

STUDIES ON SURFACE TENSION OF SELECTED JUICE FORMULATION BY DROP NUMBER METHOD USING TRAUBE'S STALAGMOMETER TECHNIQUE

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The determination of surface tension of three selected marketed juice formulations were carried out using Traube's Stalagmometer technique by drop number method which in turn aid in further identification, structural elucidation as well as determining chemical constituents. The formulation I (Orange Juice), formulation II (Aloe vera juice) and formulation III (Amla juice) were selected for the studies and were also evaluated to their same quantity mixture ratio with distilled water combination for estimation of different composition. The main aim and rationale of study was to evaluate the surface tension of selected formulations with distilled water. The 10% formulation mixture (I:II:III::1:1:1) with distilled water showed maximum surface tension (68.62 dyne/cm) and 90% formulation mixture with distilled water showed minimum surface tension (56.84 dyne/cm) amongst other compositions. The results revealed that all the percent composition values were less than standard. The 60% (58.85 dyne/cm), 70% (58.75 dyne/cm) and 80% (56.86 dyne/cm), 90% (56.84 dyne/cm) formulation mixture with distilled water showed approximately same surface tension value. In individual surface tension study, it was noted that formulation III *i.e.* Amla juice (61.24 dyne/cm) showed highest value and formulation I *i.e.* Orange juice (54.69 dyne/cm) showed lowest value comparison between three formulations under laboratory conditions.

Key words: Surface tension, Juice formulation, Drop number method, Traube's stalagmometer.

INTRODUCTION

Juice is the liquid that is naturally contained in fruit or vegetable tissue. Juice is prepared by mechanically squeezing or macerating fresh fruits or vegetables flesh without the application of heat or solvents (Franke *et al* 2005). Surface tension is the force per unit length that must be applied parallel to the surface so as to counter balance the net inward pull. Surface tension has the units of dyne/cm in the CGS system and newton/m in the SI system. Traube's Stlagmometer is an instrument for determining exactly the number of drops in a given quantity of liquid, used as a measure of surface tension of a fluid or an instrument for measuring surface tension by determining the exact number of drops in a given quantity of a liquid. The drop number method is based on the principle that a fixed volume of liquid is delivered as free falling from a capillary tube held vertically approximately proportional to the surface of the liquid. Surface tension is the result of the difference between attractions of molecule of the substance on the other side of the interface. The surface tension of distilled water is created by van der waals forces (an electronic force between the molecules in order to increase the surface tension); one would have to find a way of increasing the range of the force or strength of

these electric forces (Subramanyam, 2007; Martin, 1993; Rao, 2000; Bhal *et al* 2006). The Formulation I (Orange Juice), formulation II (Aloe vera juice) and Formulation III (Amla juice) were selected for the studies.

MATERIALS AND METHODS

Materials

Three formulations were purchased from local market. The nitric acid and acetone were purchased from Loba Chemie (Mumbai). All the chemicals used were of analytical grade.

Methods

Step I. The specific gravity bottle was cleaned thoroughly with nitric acid, the bottle was rinsed with distilled water and dried with acetone. The specific gravity bottle was accurately weighed and data was noted. Bottle was filled with water and weight was noted. Then, bottle was cleaned and dried. The bottle is then, filled with formulation I, II, III and weight was noted, respectively. The specific gravity of each of three formulations was estimated using following formula:

$$\text{Specific gravity} = \frac{\text{Mass of liquid}}{\text{Mass of equal volume of distilled water}}$$

Step II. Traube's stalagmometer was cleaned and dried and mounted in vertical plane by using burette stand. The number of drops falling down between two points of instrument was counted serially for all the liquids i.e., distilled water, formulation I, II and III. The process was repeated three times and means were calculated.

Step III. The surface tension (ST) of three selected formulations was estimated from the following formula:

ST of liquid $\gamma_1 = \gamma_2 (n_2/n_1).(\rho_1/\rho_2)$ dyne/cm

n_1 = No. of drops of liquids
ρ_1 = Density of liquid at room temperature
γ_2 = Surface tension of water at room temperature
n_2 = No. of drops of water
ρ_2 = Density of water at room temperature

Step IV. The marketed formulation mixtures were prepared at the ratio of 1:1:1 and prepare the different composition of formulation mixture with distilled water such as 10-90, 20-80, 30-70, 40-60, 70-30, 80-20, 90-10. The mixtures were weighed accurately and their specific gravity values were calculated.

Step V. Each formulations were taken into traube's stlagmometer and the no. of drops were counted and their surface tension was calculated using the formula (Mohanta and Manna, 2008; Jaliwala and Tiwari, 2009; More and Hajare, 2007; Saha *et al* 2011a; 2011b).

RESULTS AND DISCUSSION

It was found that the formulation I *i.e.* orange juice (54.69 dyne/cm) showed lowest value and formulation III *i.e.* amla juice (61.24 dyne/cm) showed highest value amongst the three formulations in individual surface tension studies under laboratory conditions (at 20°C approximately) (**Table 1**). The formulations' surface tension values showed lower values than the standard. It was found that the 90% formulation mixture (1:1:1) with distilled water (56.84 dyne/cm) showed minimum surface tension and the 10% formulation mixture (1:1:1) with distilled water (68.62 dyne/cm) showed maximum surface tension amongst the other composition. The 60% (58.85 dyne/cm), 70% (58.75 dyne/cm), 80% (56.86 dyne/cm) and 90% (56.84 dyne/cm) formulation mixture (1:1:1) with distilled water showed approximately same values (**Table 2**).

Table 1. Specific gravity formulation at 20°C

S. No.	Standard/ Formulations	No. of drops			Mean no. of drops	Specific gravity	Surface tension (dyne/cm)
		1	2	3			
1	Standard: Distilled water	76	72	74	74	1	72.8
2	Formulation I (Orange Juice)	117	122	116	118	1.198	54.69
3	Formulation II (Aloe vera juice)	93	97	95	95	1.025	58.12
4	Formulation III (Amla Juice)	93	91	92	92	1.032	61.24

Table 2. Surface tension of composition of mixture of formulation (1:1:1) and distilled water at 20°C

S. No.	Composition of formulation mixture (1:1:1) with distilled water (%)	No. of drops			Mean no. of drops	Specific gravity	Surface tension (dyne/cm)
		I	II	III			
1	Standard : Distilled water	76	72	74	74	1	72.8
2	10%	77	81	77	79	1.007	68.62
3	20%	79	85	79	81	1.016	67.59
4	30%	85	87	80	84	1.024	65.6
5	40%	84	90	96	90	1.031	61.69
6	50%	94	92	96	94	1.041	59.64
7	60%	95	99	94	96	1.05	58.85
8	70%	94	98	99	97	1.059	58.75
9	80%	102	100	101	101	1.067	56.86
10	90%	100	104	102	102	1.077	56.84

CONCLUSION

The study was found to be significant for determining individual surface tension of each marketed formulation and their ratio with distilled water for estimation of various compositions of the mixture.

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