

Effects of Soft Drinks on Seed Germination and Early Seedling Growth of *Vigna radiata* (L.) Wilczek

Ardra P¹., Ameesha M.M². and Jisha K.C.*

^{1,2}BSc students, ²Assi Prof., Department of Botany, MES Asmabi College, P. Vemballur, Thrissur. Dt. Kerala, India. jishakc123@gmail.com

Abstract

In the present research work the effects of various soft drinks on the seed germination and early seedling growth of *Vigna radiata* (L.) Wilczek were studied. The seeds of *V. radiata* were surface sterilized and allowed to germinate in Petri plates lined with cotton which were soaked with different soft drinks. In all the soft drinks tested, no germination was obtained. Thus we germinated the seeds in cotton soaked with water and poured soft drinks in the subsequent days. After 10 days of growth, the growth parameters of seedlings were noted. The major seedling growth parameters analysed include shoot length, fresh weight, dry weight, dry weight percentage and moisture content percentage. From the results, it was found that the soft drinks inhibited the seed germination and caused significant reduction in the early seedling growth of *Vigna radiata* (L.) Wilczek. Based on the survey conducted among the college students, a clear shift from consumption of soft drinks to fresh juice was identified and is good indication for a healthy future.

Keywords: Germination, growth, seedling, soft drinks Portraits.

1. Introduction

Soft drinks are non alcoholic water based flavoured drink which are sometimes may be

sweet, carbonated or acidulated, and may have salts or various fruit juices. Several aromatic compounds or vegetable extracts contribute the flavor to soft drinks. They supply basically no major nutrients and are often sweetened with sugar. Soft drinks flavours may be of artificial or natural in origin. Acids like phosphoric acid and citric acid provide tart taste and they can also serve as preservatives. Colouring agents may also be added to soft drinks. According to the British Soft Drinks Association Annual Report (2016), the overall consumption of soft drinks in the UK has enhanced fairly from 2010 to 2015 by 0.2%. In 2015; 13.3 billion litres of soft drinks were used and 13.2 in 2010 with more than half (58%) of the consumption was of no or low calorie types (0–20 kcal per 100 ml).

Soft drinks may have colourings, caffeine, preservatives and other ingredients. Sometimes, very minute amount of alcohol may be present in a soft drink, but the alcohol level should always be less than 0.5% of the total volume of the drink in many localities and countries. Commercial soft drinks first appeared in 1884 when a product called “Moxie” was made by a drugstore owner in Lisbon Falls in the USA (Tahmassebi *et al.* 2006).

Some soft drinks possess harmful effect on the general and dental health of people including adults and children. Many efforts are made by governments and manufacturers to decrease the harmful effects of soft drinks on general health and teeth. These efforts

include prohibition of soft drink sales in schools, restricting the advertising of soft drinks, altering the composition of soft drinks and implementing tax on sugar-containing soft drinks. In addition to these harmful effects, soft drinks also possess some useful aspects also. Energy drinks always hold high sugar and caffeine, thus they can improve the physical and mental performance, improve alertness, endurance, concentration and mood (Bunting *et al.* 2013). The caffeine content and concentration vary generally between the different brands and labelling of the amount of caffeine in these drinks is not mandated by the Food and Drug Administration of the USA (Rath 2012).

There are many reports on the effects of soft drinks on human health. But research work related to the influence of these soft drinks on plant growth is very less. The present research paper discusses the effects of eight common soft drinks on and early seedling growth of *Vigna radiata* (L.) Wilczek.

2. Methodology

2.1. Materials

Plant material

The research was carried out with the seeds of *Vigna radiata* (L.) Wilczek which were procured from the local stores of Kodungallur.

2.2 Soft drinks

Commonly used soft drinks like Sprite, 7-up, Appy Fizz, Mirinda, Limca, Frooti, Slice and Mountain Dew were used for the study.

Incubation of *Vigna radiata* seeds in the Petri dishes

Healthy and plummy seeds of *V. radiata* were washed with 0.1% mercuric chloride,

detergent solution and distilled water to remove any dirt present on the seed surface. The washed seeds were surface dried by using filter paper. All the seeds were allowed to germinate in Petri dishes containing absorbent cotton soaked with distilled water (control) and different soft drinks (treatment). All the Petri dishes were kept in the culture racks under controlled light and temperatures. Seeds were allowed to germinate and examined regularly for the data collection.

Determination of shoot length, fresh weight, dry weight, dry weight percentage and moisture content percentage

Shoot length of seedlings were measured by using scale. Measurements were taken in seedlings which were nine days old. The seedlings were weighed using electronic balance. For fresh weight and dry weight measurements, the seedlings were blotted and wrapped separately in pre-weighed labelled aluminium foils. Fresh weight of the samples was determined by weighing them immediately after wrapping. For dry weight measurements the samples were kept in a hot air oven at 100⁰ C for one hour followed by at 60⁰C for overnight. After 48 h, the samples were transferred to a desiccator, allowed to cool and then weighed. The samples were reweighed as described above at regular intervals (24h), until the weights became constant. The dry weight percentage was calculated by using the following formula:

$$\text{Dry weight percentage} = \frac{\text{Dry weight}}{\text{Fresh weight}} \times 100$$

Moisture content percentage was calculated by using the following formula

$$\text{Moisture content percentage} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

Survey methodology

A survey was conducted by using questionnaire method (Table 1). On line

survey was conducted among the students of various departments and among neighbours by using google forms and got 150 responses. The responses were analysed according to the options given in the questionnaire.

Statistical analysis

The results were analysed by using Microsoft excel. Standard deviation and standard error were determined for each category of data.

3. RESULTS

3.1. Germination percentage

As far as the germination percentage of *V. radiata* seeds was concerned, all the seeds incubated in soft drinks failed to germinate, but in controls, 100% seed germination was achieved.

Shoot length, fresh weight, dry weight, dry weight percentage and moisture content percentage

Since, all the seeds in the treatments failed to germinate under soft drinks, the seeds were first allowed to germinate in normal distilled water and after germination, different soft drinks were poured in different Petri plates (Plate 1).

The shoot length of seedlings was found to be highest in the case of seedlings treated with Sprite (20.3 cm) and lowest shoot length was recorded in the seedlings raised in Fanta (14.6 cm) (Fig. 1) (Plate 2).

As far as the fresh weight parameter was concerned, highest fresh weight was observed in the seedlings grown in control conditions (0.349 g) and lowest fresh weight was observed for seedlings grown under Mirinda (0.253 g) (Fig. 2). Maximum dry weight and minimum dry weight of seedlings were

recorded under Mountain Dew (0.0312 g) and Appy Fizz (0.013 g) respectively (Fig. 3). Highest dry weight percentage was recorded by the seedlings grown in Fanta (10.76), while lowest dry weight percentage was recorded by seedlings grown in Appy Fizz (4.7) (Fig. 4). In the case of moisture content percentage, the highest moisture content percentage was observed in the seedlings raised in Appy Fizz (95) and lowest was observed in the seedlings raised in Fanta (89) (Fig. 5).

3.2. Survey Results

From the survey report it was found that the major age group in this survey belongs to 17-20 who are the major consumers of the soft drinks (55%) (Fig. 6). Majority preferred fresh juice (37%) and among the soft drinks, 7 up secured the first position of choice (28%) (Fig.7). Females constitute 53% of this survey and majority of the respondents (48%) revealed that they consume soft drinks once in a month (Fig. 8). Among the respondents, 4% consume the soft drinks in empty stomach (Fig. 9) and among the respondents majority were females (53%)(Fig. 10) and about 65% of respondents were attracted by the taste of the soft drinks (Fig. 11). 71% of the respondents were aware about the artificial flavouring (Fig. 12) and 56% were aware on the sugar content in the soft drinks (Fig. 13). Among the respondents, 45% claim that they got some times energy on soft drinks consumption (Fig. 14) and 80% claim that they never felt addiction towards soft drinks (Fig. 15). Majority of the respondent (80%) claim that they never experienced any side effects due to soft drinks (Fig. 16) and 58% agreed that the soft drinks mainly aim at children and youth (Fig. 17). Majority of the respondents (92%) consume the soft drinks without storing it (Fig. 18) and moreover, majority (90%) preferred to have the soft drinks in chilled conditions (Fig. 19). Majority

of respondent (70%) not consider themselves as very health conscious about the consumption of soft drinks (Fig. 20).

4. Discussion

The consumption of soft drinks was found to have enhanced considerably over the past several decades with the highest increase among adults and children. Extreme consumption of soft drinks with elevated sugar and acid content in both regular and diet could lead to harmful effects on general and dental health including overweight, dental caries, obesity, dental erosion, and increased risk of type 2 diabetes. Due to these detrimental effects of soft drinks on human health, the current research work was an attempt to investigate whether these so called soft drinks has harmful or beneficial effects on cytology, seed germination and early seedling growth of plants.

In the present reaearch work, there was no significant reduction or increase in the seedling growth parameters of *V. radiata*, was resulted. But all the seedlings which were raised in soft drinks were weak and about to collapse. It indicated the harmful effects of the soft drinks on seedling growth. According to Grant (2014), sugary sodas did not aid in a plant's development and, in fact, could reduce the absorption of nutrients and water, resulting in death of plants. The online survey showed that majority of people now changed the soft drink consumption to fresh juices due to the increased risk of the soft drink side effects. This is good indication that our society started to thick positively and avoiding these synthetic soft drinks.

Thus from the present research work, it was clear that these soft drinks not only affects the human health, but also cause significant negative impact on the seed germination and seedling growth of plants.

5. Summary and conclusion

In the present research work the effects of various soft drinks on the seed germination and early seedling growth of *Vigna radiata* (L.) Wilczek were studied. The seeds of *V. radiata* were surface sterilized and allowed to germinate in Petri plates lined with cotton which were soaked with different soft drinks. In all the soft drinks tested, no germination was obtained. Thus we germinated the seeds in cotton soaked with water and poured soft drinks in the subsequent days. After 10 days of growth, the growth parameters of seedlings were noted. The major seedling growth parameters analysed include shoot length, fresh weight, dry weight, dry weight percentage and moisture content percentage. For anatomical studies, thin sectioned were prepared from roots and stem of seedlings and it revealed significant deposition of colouring agents and other chemicals in the inner tissues. From the results, it was found that the soft drinks inhibited the seed germination and caused significant reduction in the early seedling growth of *Vigna radiata* (L.) Wilczek. From the survey conducted among the college students, it was found that majority of the students prefer fresh juice and very less percentage of students prefers soft drinks. Thus it can be concluded that in the current scenario, the younger generation could recognize the health problems related to soft drinks and a clear shift was visible in their choice.

References

British Soft Drink Association Leading the Way. UK soft drinksannual report, 2016. [http://www.britishsoftdrinks.com/write/Uploads/Publications/BSDA Annual report 2016.](http://www.britishsoftdrinks.com/write/Uploads/Publications/BSDA%20Annual%20report%202016)

Bunting, H., A. Baggett & J. Grigor, 2013. Adolescent and young adult perception of caffeinated energy drinks. *A qualitative approach Appetite*65:132–8.

Grant, A. 2014. "Is Soda Pop A Fertilizer? Information About Pouring Soda On Plants." Is Soda Pop A Fertilizer? Information About Pouring Soda On Plants. n. p. n.d. Web.

Rath, M. 2012. Energy drinks: what is all the hype? The dangers of energy drink consumption. *Journal of American Academy of Nurse Practitioners*24:70–6.

Tahmassebi, J.F., M.S. Duggal, G. Malik-Kotru & M.E. Curzon, 2006. Soft drinks and dental health: a review of the current literature. *European Archives of Paediatric Dentistry*34:2–11.

Revised and Accepted: 22st February 2020

Published: 31st July 2020

Table 1: Questionnaire

Q No	Question	Options
1	What is your age limit?	1:17-20 2:21-25 3:25-35 4:35-50 5:Above 50
2	Which soft drink do you prefer the most?	1: Sprite 2: Mountain Dew 3: Appy Fizz 4: Slice 5: 7 Up 6: Fanta 7: Mirinda 8: Limca
3	What is your gender?	1: Male 2: Female 3: Others
4	How often do you consume soft drinks?	1: Daily 2: Weekly 3: Monthly 4: Never
5	Did you consume it in an empty stomach?	1: No 2: Yes 3: Sometimes
6	When choosing a soft drink what influences your decision?	1: Taste 2: Quality 3: Nothing
7	Are you concerned about the use of artificial flavouring and sweetness in soft drinks?	1: No 2: Yes
8	Are you concerned by the levels of sugar in soft drinks?	1: No 2: Yes
9	Did you get energy by consuming the drink?	1: No 2: Yes 3: Sometimes
10	Have you had any addiction to any of these drinks?	1: No 2: Yes 3: Sometimes
11	Did you find any side effects using these soft drinks?	1: No 2: Yes 3: Sometimes

12	Soft drinks are mainly aimed at children and youth?	1:Strongly agree 2:Agree 3:Disagree 4:Strongly disagree
13	How many days did you store these soft drinks?	1: 1-3 Days 2: 3-6Days 3: More than 7 days 4: A month
14	At what temperature did you like to consume these soft drinks?	1: Chilled or cold 2:Room temperature
15	How health conscious do you consider yourself to be?	1: Not very 2:Very health conscious

Plate 1: Growth of *V. radiata* seedlings in control and different soft drinks



Plate 2: Measurement of shoot length in *V. radiata* seedlings raised in control and different soft drinks

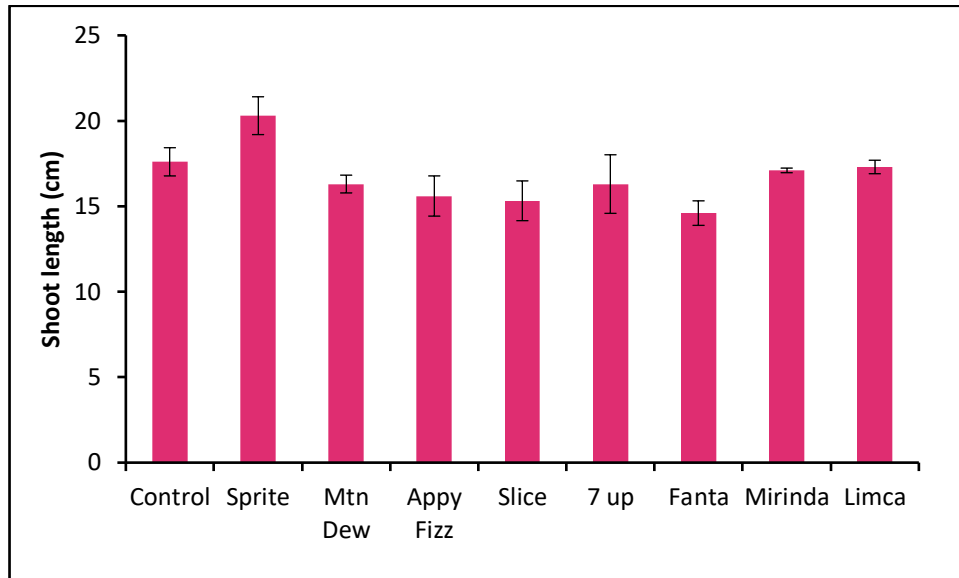


Fig. 1: Shoot length of *V. radiata* Wilczek seedlings raised under control and different soft drinks. The vertical bars represent SE of the mean value of recordings from two independent experiments each with a minimum of four replicates.

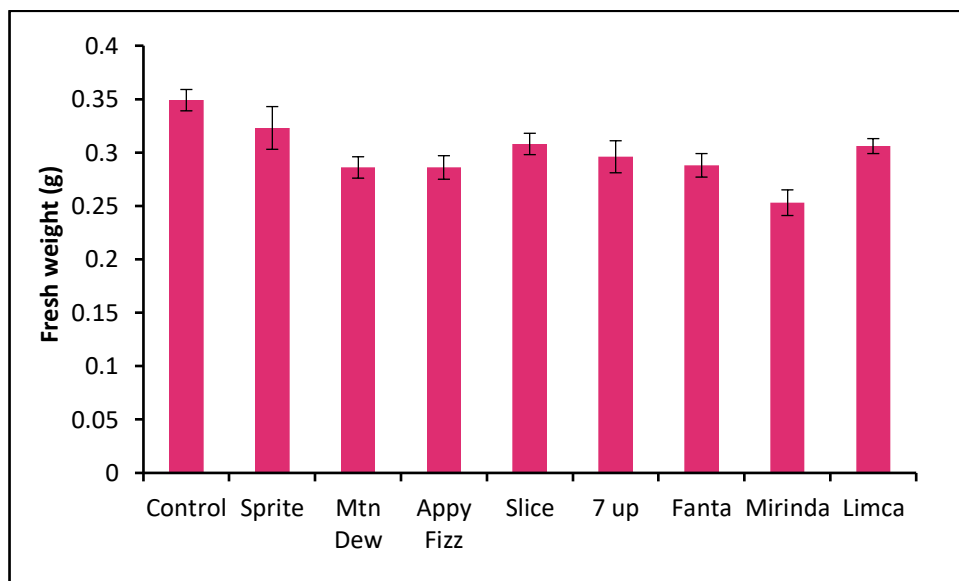


Fig. 2: Fresh weight of *V. radiata* Wilczek seedlings raised under control and different soft drinks. The vertical bars represent SE of the mean value of recordings from two independent experiments each with a minimum of four replicates.

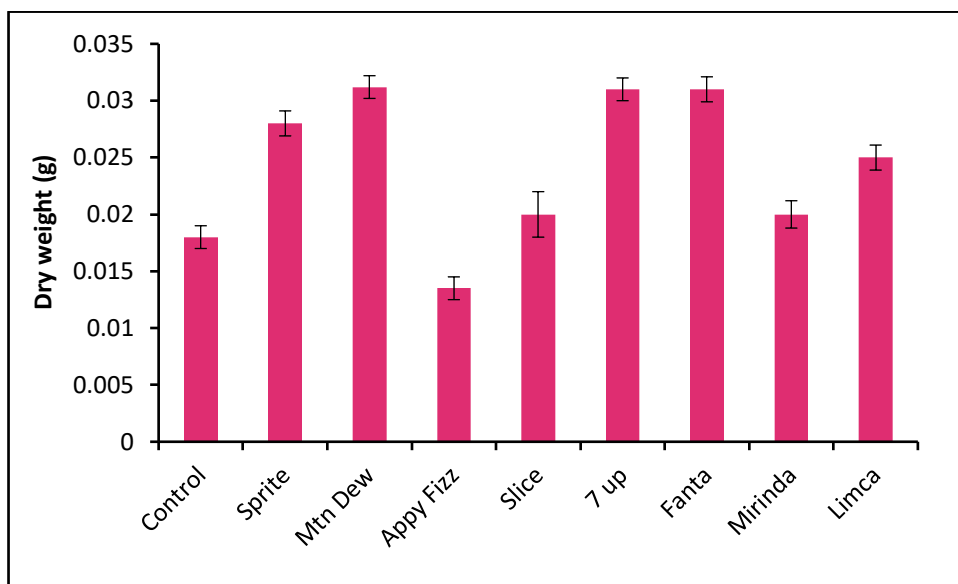


Fig. 3: Dry weight of *V. radiata* Wilczek seedlings raised under control and different soft drinks. The vertical bars represent SE of the mean value of recordings from two independent experiments each with a minimum of four replicates.

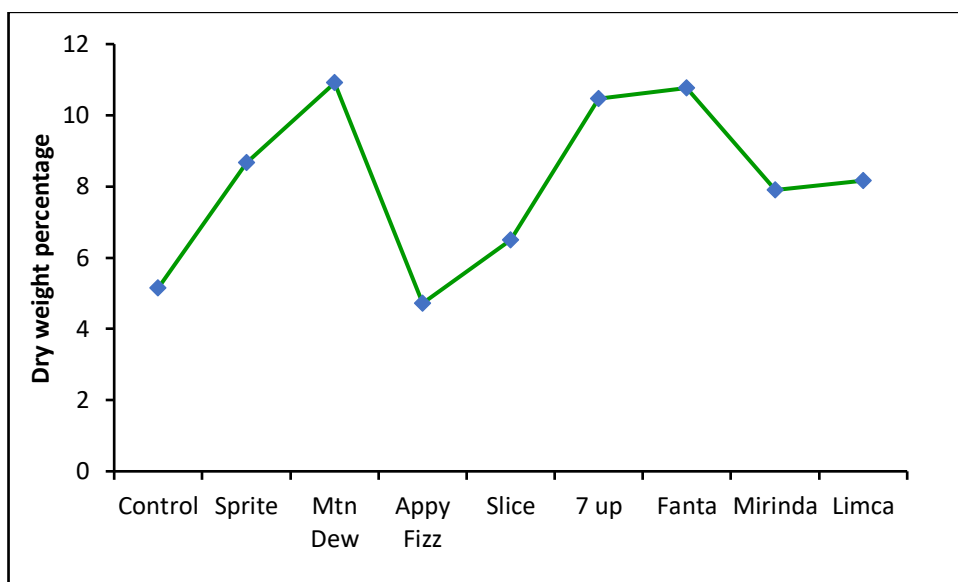


Fig. 4: Dry weight percentage of *V. radiata* Wilczek seedlings raised under control and different soft drinks. The vertical bars represent SE of the mean value of recordings from two independent experiments each with a minimum of four replicates.

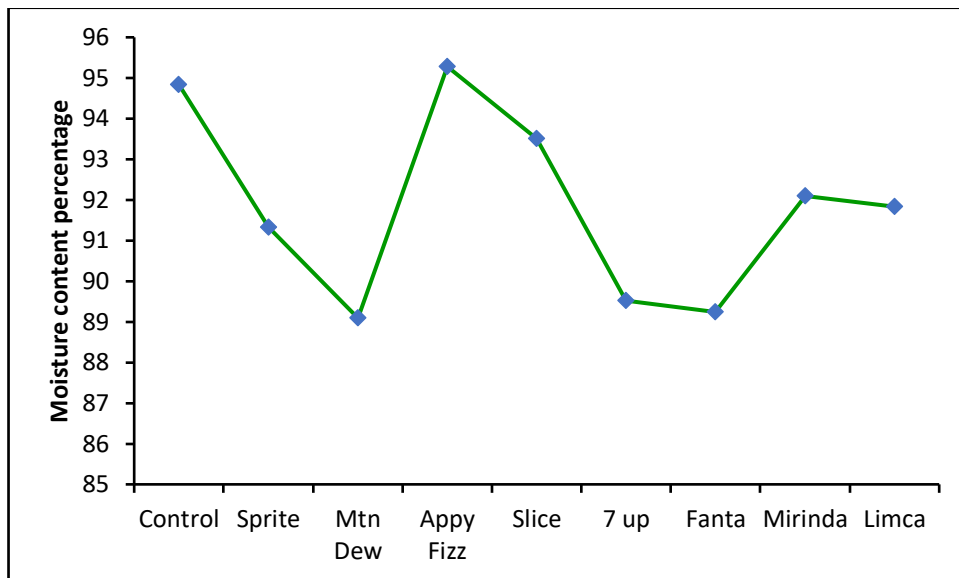


Fig. 5: Moisture content percentage of *V. radiata* Wilczek seedlings raised under control and different soft drinks. The vertical bars represent SE of the mean value of recordings from two independent experiments each with a minimum of four replicates.

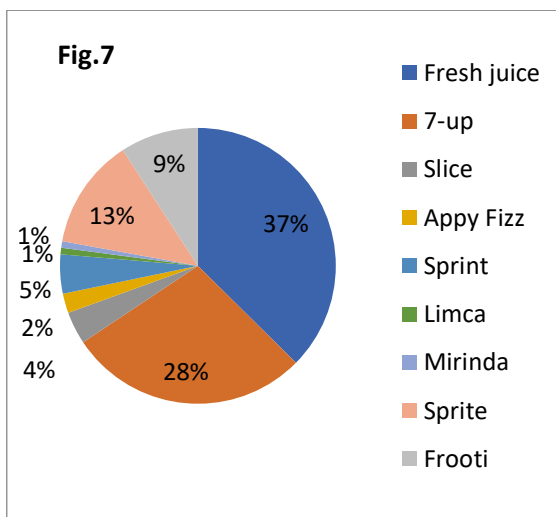
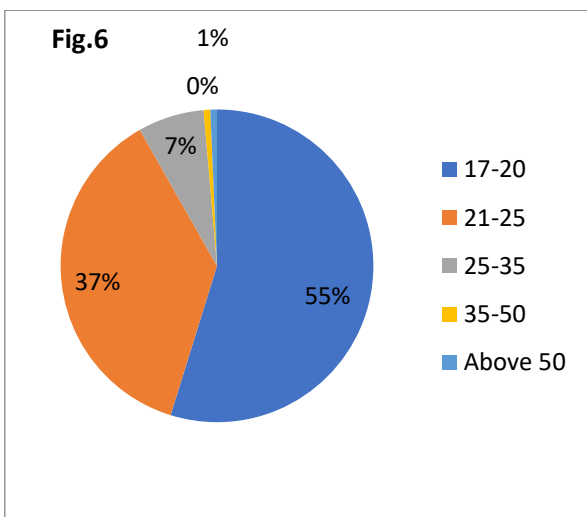


Fig. 6: Diagram showing the age group of respondents

Fig. 7: Diagram showing the preference of soft drinks

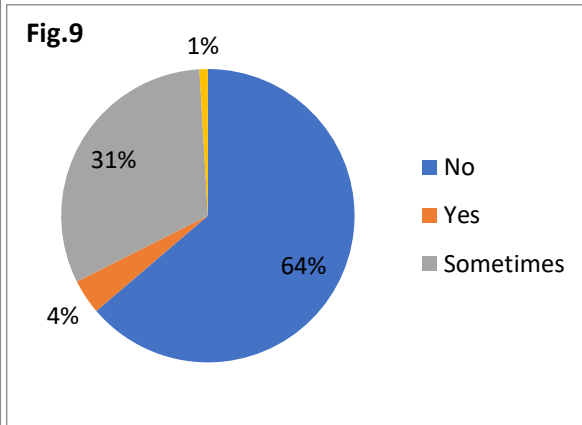
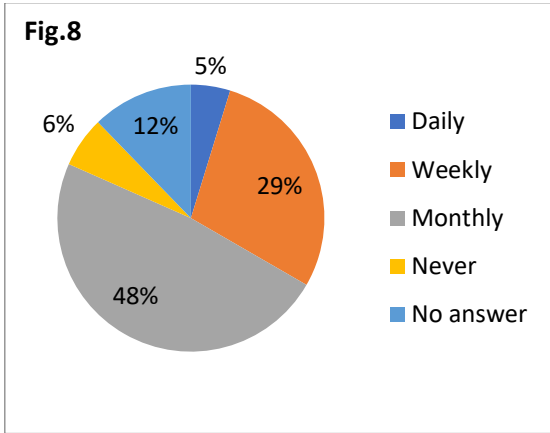


Fig. 8: Pie diagram showing how often the soft drinks consumption

Fig. 9: Diagram showing consumption of soft drinks in empty/not empty stomach

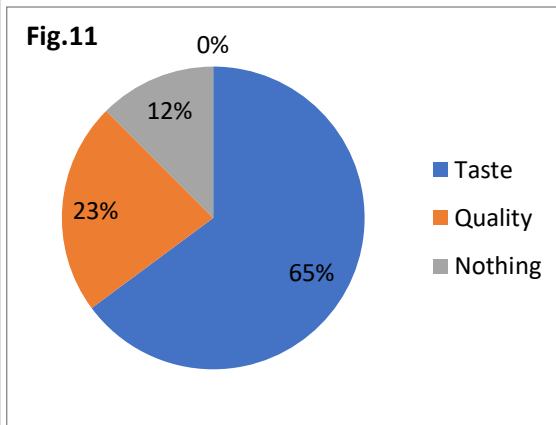
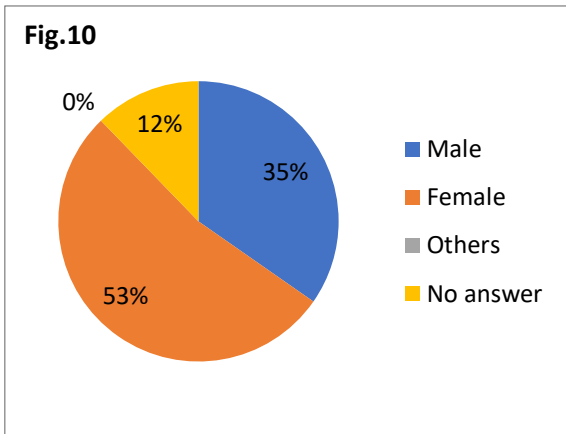


Fig. 10: Diagram showing the gender of respondents

Fig. 11: Diagram showing the preferred attributes of soft drinks

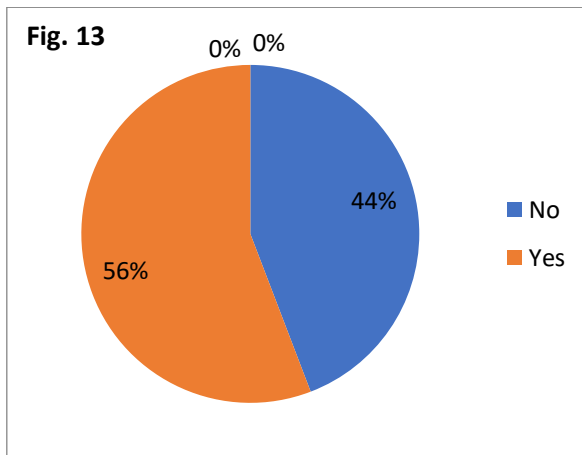
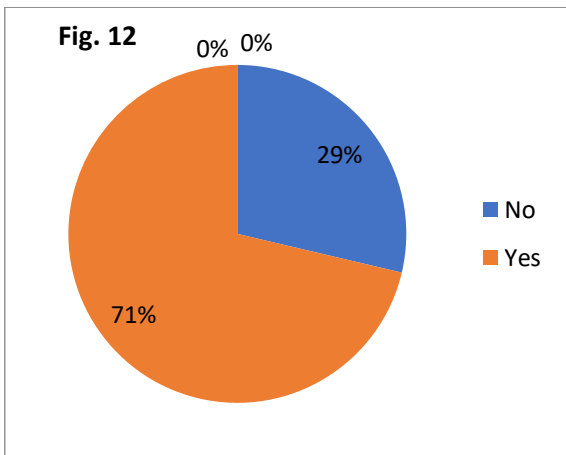


Fig. 12: Diagram showing the awareness about the artificial flavouring in soft drinks

Fig. 13: Diagram showing the awareness about the sugar content in soft drinks

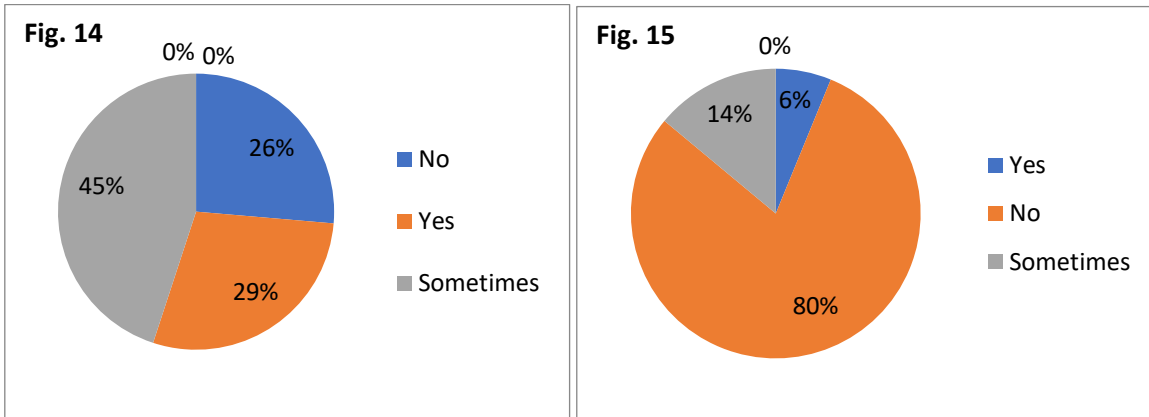


Fig. 14: Diagram showing the data regarding energy attainment due to soft drinks

Fig. 15: Diagram showing the addiction of soft drinks of respondents

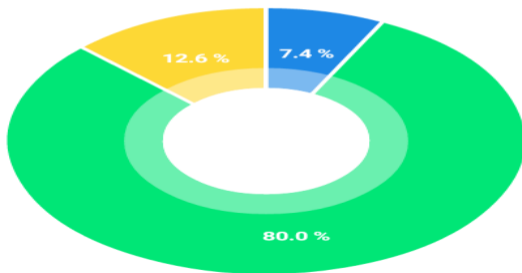
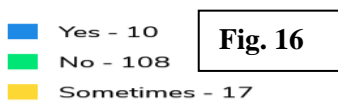


Fig. 16: Diagram showing experience of soft drinks side effects

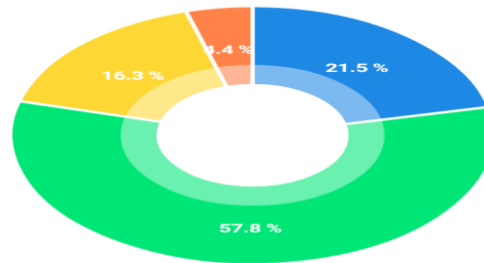
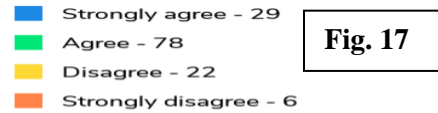


Fig. 17: Diagram showing the opinion regarding the target of soft drinks as children and youth

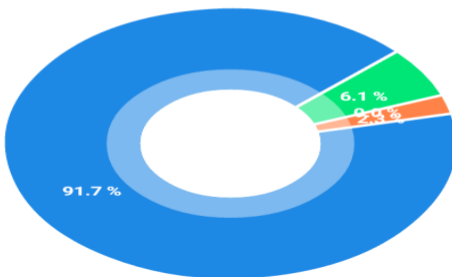
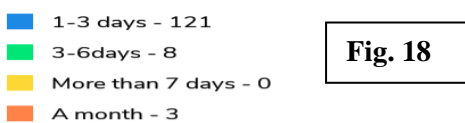


Fig. 18: Diagram Aregarding the storage of soft drinks

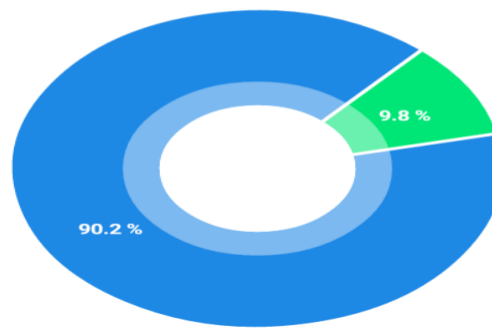
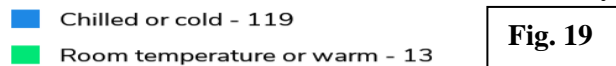


Fig. 19: Diagram showing the preferred temperature for the consumption of soft drinks

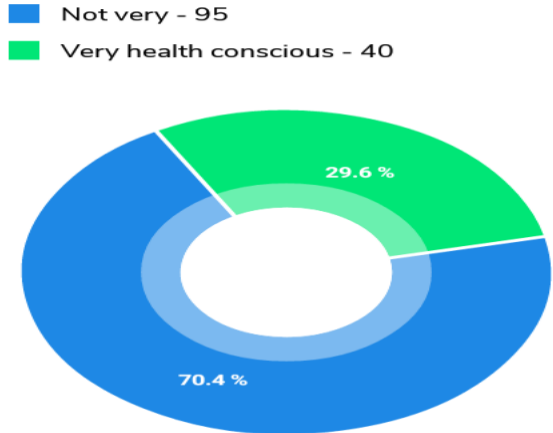


Fig. 20: Diagram showing the health conscious about soft drinks