

# GROWTH DIVERSITY OF SELECTED BEVERAGES IN *VIGNA RADIATA* (L.)

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## Abstract

Pulses are an important protein source of vegetarian diet. Sprouting is the practice of soaking, draining and then rinsing seeds at regular intervals until they germinate, or sprout. A genetic change results in a new genetic pattern, which is passed from one generation to next. The importance of the studies on various aspects of beverages has received much attention in recent years. These contain stimulants or flavouring agents which perform some useful functions but are not essential for the proper functioning of the body. Nowadays cancer has become a common disorder to many people. The Chromosomes of cancer cells frequently shows chromosomal abnormalities or mutations. The types of abnormalities observed with these mutations are seen in cancers caused by various mutagenic or carcinogenic (cancer-inducing) agents. Our life style – food, nutrition, cosmetics, drinks all have a very good role in the determination of the future of a person. In the present investigation, an effect of black coffee and black tea on seed germination of *Vigna radiata* (L.) was taken. Different concentrations and durations also studied. Observations revealed that black tea had a very good vigour index than black coffee and control.

**Keywords:** Pulses; germination; beverages; vigour index; growth response.

## Introduction

Pulses, belonging to the family Fabaceae, are an important protein source of vegetarian diet. Besides they also serve as excellent foliage and cattle feed. Chickpea (*Cicer arietinum*), Cowpea (*Vigna unguiculata*) and Green Gram (*Vigna radiata*) are the three main pulse crops of India.

Chickpea (*Cicer arietinum*) – pulse crop of India, belonging to the family Fabaceae, is originated from Southwest Asia. The seeds are wrinkled or smooth and the cotyledons are thick and yellowish. Seeds of Chickpea contain 17.1% protein, 5.3% fats, 61.2% carbohydrates, 3.9% fibres and 2.7% minerals. Cowpea (*Vigna unguiculata*) is one of the principal pulses commonly used in India. It is a native of Central Africa. The seeds are globular or kidney-shaped, smooth or wrinkled and are of various colours. The dry seeds contain 24.6% proteins, 55.7% carbohydrates, 1.3% fats, 3.8% fibres and 3.2%

minerals. Green gram (*Vigna radiata*) is a native to India, where it has been cultivated since ancient times. The dried seeds of Green gram contain 23.6% protein, 58.2% carbohydrates, 1.2% fats, 3.3% fibres and 4% minerals.

Many liquids or liquorous foods such as coffee, tea, soft drinks and alcohol containing drinks are considered beverages. They contain stimulants or flavouring agents which perform some useful functions but are not essential for the proper functioning of the body. The importance of the studies on various aspects of beverages has received much attention in recent years.

Many physical and chemical agents are known to produce chromosomal aberration and gene mutations in both plant and animal cells (D'Amato, 1950). In recent years many substances present in the environment have been

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found to be capable of inducing chromosome aberrations and gene mutations (Betina and Murin, 1964; De Serees, 1976; Abraham and Cherian, 1976, 1978; Abraham and Pillai, 1979). Beverages are stimulatory in nature and man feels some pleasure by taking them. Some substances obtained from plants like cocaine, cannabis, opium, etc. are highly stimulant, whereas others like tea, coffee cocoa etc are mild stimulant. Nowadays beverages are used in enormous quantity throughout the world and they have become an integral part of the human diet (Singh *et al.*, 2005). The word coffee originated from “Kaffa” the name of a district in Shoa, South-west Abyssinia where the coffee plant was first discovered. Coffee (*Coffea*) is an evergreen shrub or small tree indigenous to central Africa Asia belongs to the family Rubiaceae. Coffee is mainly used as a beverage in the form of aqueous extract prepared from roasted and powdered seeds. Coffee is used for flavouring ice creams, candies and pastries. In medicines, it is used as a stimulant, nervine and diuretic. Bad effects of excessive use of coffee are due to the presence of a volatile toxic substance, called Cafe toxin (Singh *et al.*, 2005).

Tea is the queen of beverages, and no other beverage except water is consumed by so many. Tea is a treasure of the world, is the most important non-alcoholic beverage; it is a pure, safe and helpful stimulant and one of the chief joys of life. The tea plant is an evergreen of the *Camellia* genus and is known as *Camellia sinensis* belonging to the Family Theaceae, flourishes in warm tropical and subtropical rainy regions. The tea plant is considered to be a native of Assam and the adjoining areas of Upper Burma, some regard to be a native of southern Yunnan and Upper Indo-China.

The distinctive character of tea is mainly due to three principal constituents, essential oils, alkaloid fraction and polyphenols. The aroma and flavour of tea is due to the presence of ethereal oil, theol; the stimulatory and refreshing properties due to caffeine alkaloid; and the bitterness

and astringency due to polyphenols (tannins). Chemically, tea consists of 2.5% theine, 13-18% polyphenols and essential oils. In addition it contains several of the B-complex vitamins and nicotinic acid. It is astringent, stimulant, diuretic and nervine.

The present investigation aims at studying the effect of black coffee and black tea on the seed germination of *Vigna radiata* (L.) in varying concentration and duration, because seed is the starting organ which is viable for months or even years. The seed germinates to give rise to the seedling and eventually matures into a plant. According to Pandey (1996), seed is the miniature of the plant body which is resistant to extreme conditions of climate and can persist over a considerable period of time without apparent morphological changes.

## Materials and Methods

### Materials

Chickpea (*Cicer arietinum*), Cowpea (*Vigna unguiculata*) and Green Gram (*Vigna radiata*) were chosen as the test materials for the present investigation. Commercially available seeds washed and dried in sun light were used. Treatment materials were prepared by adding different weighed grams of powder form of back coffee (*Coffea arabica*) and black tea (*Comellina sinensis*).

### Preparation of Sample solution

Different gms. (1, 2, 3, 4, 5) of each coffee and tea powder are weighed and put in to 100 ml. of boiled tap water. For saturation, the solution was kept over the flame for 5 minutes. After that, allowed the sample solutions for cooling. The cooled, saturated test materials were filtered. Different concentrations of the filtrate were used as the treatment solution. Along with the treatments, 100 ml. of boiled and cooled tap water is used as the control.

### Pilot Experiment

A pilot experiment was conducted by using one

gram powder each of tea and coffee put into 100 ml. boiled tap water in conical flasks. Along with this 100 ml. of boiled tap water was considered as control. Fifty numbers each of three different pulses carefully put into the treatment solutions. Each of the conical flasks covered with cotton plug. The test materials were soaked for 2 hrs. After soaking, de-can the solution and 5 seeds of each pulse were sown in soil (*in vivo*) and in petri plates (*in vitro*). Five replications of the same were also made.

### Experiment

After the pilot experiment, *Vigna radiata* was chosen to study the effect of different concentrations of black coffee and black tea powder on the germination. The concentrations selected were 1, 2, 3, 4 and 5 gm. per 100 ml. (1%, 2%, 3% 4% and 5%). The selected test material was soaked for two different durations, 2 hrs. and 4 hrs (labelled as C<sub>p</sub>d, T<sub>p</sub>d and Cod; where C – Coffee, T – Tea, p – Percentage and d – Duration in hrs.; Co - Control).

### Methods

The seedling growth in petri plates for 24, 48, 72 and 96 hrs. were used for the study. Five seedlings of uniform growth were selected from each petri plate and different growth measurements were taken. The following morphological parameters were studied:

**Germination Percentage:** Watering was done daily once and observations were made. The germination percentage was calculated using the formula

$$\frac{\text{No. of seeds germinated} \times 100}{\text{Total number of seeds}}$$

**Root Length:** For root length measurement, the lengths of the tap root of different seedlings were measured with a metre scale and care was taken to minimize the damage to the tap root. From these values average length of tap root was determined and was considered as the

length of root.

**Shoot Length:** Shoot length measurement was taken from the part of the joint of root and shoot to the middle of the unopened leaves. Average shoot length of seedlings was determined and expressed in centimetres.

**Whole Seedling Length:** The length of root and shoot together gives the length of whole seedling.

**Number of Lateral Roots per Plant:** The number of lateral roots per tap root was counted and very small lateral roots were eliminated.

**Vigour Index:** Vigour index of the seedling was calculated on the basis of length, by multiplying the percentage of germination with the average seedling length (Abdul-Baki and Anderson, 1973).

$$\text{Vigour Index} = \frac{\text{Germination Percentage} \times \text{Average Seedling Length}}{\text{Average Seedling Length}}$$

### Results and Discussion

#### Pilot experiment

Among the three pulses *Cicer arietinum*, *Vigna unguiculata* and *Vigna radiata*, *Vigna radiata* had shown the maximum response to the two treatment materials, black coffee and black tea in *in vitro* and *in vivo* conditions (Table 1).

A constant observation on the germination of *Vigna radiata* was conducted daily. On the first day, all the treatments with different durations and controls had shown the emergence of radicle. On the second day, it elongated and attained a maximum on the fourth day (96 hrs.). So, the parameters studied were measured on the fourth day.

#### Germination Percentage

Germination percentage were found 100% for the treatment with different concentrations of

the black coffee and black tea. The percentage was found less for the control (Table 2).

### Root Length

In case of root length, it showed a gradual increase with the advancement of growth period. A significant effect in root length was observed. The highest value (5.32 cm.) was noticed in 4% of black tea treated for 2 hrs. duration and the lowest value (2.10 cm.) in 3% of black coffee treated for 4 hrs. duration (Table 3).

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### Shoot Length

It was found that the treatment of black tea had a beneficial effect on shoot length. The highest average value of shoot length 7.14 cm. was observed in 1% black tea treated for 4 hrs. duration (Table 4). The average lowest value (2.00 cm.) was noticed in 5% black coffee treated for 2 hrs. The average shoot length value in control for 2 hrs. and 4 hrs. were 2.70 cm. and 4.10 cm. respectively.

### Whole Seedling Length

Regarding the whole seedling length, the lowest mean value observed in black coffee treatment compared to black tea treatment. The lowest mean seedling length, 4.50 cm., was found in *Vigna radiata* treated for 4 hrs. in 3% of black coffee (Table 5). Among the black coffee treatments, the highest mean value, 8.56 cm., was noticed in 2% black coffee treated for 2 hrs. duration. *Vigna radiata* had shown the highest mean value, 12.18 cm., in 1% black tea treated for 4 hrs. duration.

### Number of Lateral Roots per Plant

The highest average number of lateral roots per plant (11) observed in 1% of black coffee treated for 2 hrs. and in 5% of black tea treated for 4 hrs. duration. Both the control materials had shown the lowest number of lateral roots per plant (Table 6).

### Vigour Index

All the treatments have a promotive vigour index on length basis. Among all the treatments black tea had shown a higher value for vigour index (Table 7). The highest value, 1218, was found in 1% black tea treated for 4 hrs. duration. The lowest value, 450 observed in 3% black coffee treated for 4 hrs.

A pulse, sometimes called a "grain legume", is an annual leguminous crop yielding from one to twelve seeds of variable size, shape, and colour within a pod. Pulses are used for food for humans and other animals. Pulses provide protein, complex carbohydrates, and several vitamins and minerals. Like other plant-based foods, they contain no cholesterol and little fat or sodium. Pulses also provide iron, magnesium, phosphorus, zinc and other minerals, which play a variety of roles in maintaining good health.

Pulses are 20 to 25% protein by weight, which is double the protein content of wheat and three times that of rice. While pulses are generally high in protein, and the digestibility of that protein is also high, they are often relatively poor in methionine, an essential amino acid. Grains (which are themselves deficient in lysine) are commonly consumed along with pulses to form a complete diet of protein.

The seeds are the principal means of perpetuation of the species. It is the miniature of the plant body. The seed encloses an embryo, which consists of radicle, plumule and cotyledons. The embryo remains dormant within the seed. The farmers and horticulturists are interested in the

**Table 1.** Response of different test materials in pilot experiment

Test Materials	Germination Percentage					
	<i>in vitro</i>			<i>in vivo</i>		
	Control	Coffee	Tea	Control	Coffee	Tea
<i>Cicer arietinum</i>	61	22	45	51	12	0
<i>Vigna unguiculata</i>	89	41	55	81	63	78
<i>Vigna radiata</i>	85	100	100	82	100	100

**Table 2.** Germination percentage of *Vigna radiata* in treatment materials for different durations

Treatment	Germination Percentage			
	2 hrs. Duration		4 hrs. Duration	
Control	Co2	80	Co4	85
Coffee	C <sub>1</sub> 2	100	C <sub>1</sub> 4	100
	C <sub>2</sub> 2	100	C <sub>2</sub> 4	100
	C <sub>3</sub> 2	100	C <sub>3</sub> 4	100
	C <sub>4</sub> 2	100	C <sub>4</sub> 4	100
	C <sub>5</sub> 2	100	C <sub>5</sub> 4	100
Tea	T <sub>1</sub> 2	100	T <sub>1</sub> 4	100
	T <sub>2</sub> 2	100	T <sub>2</sub> 4	100
	T <sub>3</sub> 2	100	T <sub>3</sub> 4	100
	T <sub>4</sub> 2	100	T <sub>4</sub> 4	100
	T <sub>5</sub> 2	100	T <sub>5</sub> 4	100

**Table 4.** Shoot length of *Vigna radiata* in treatment materials for different durations

Treatment	Average Shoot Length (cm.)			
	2 hrs. Duration		4 hrs. Duration	
Control	Co2	2.70	Co4	4.10
Coffee	C <sub>1</sub> 2	3.00	C <sub>1</sub> 4	4.80
	C <sub>2</sub> 2	4.06	C <sub>2</sub> 4	2.50
	C <sub>3</sub> 2	2.40	C <sub>3</sub> 4	2.40
	C <sub>4</sub> 2	3.40	C <sub>4</sub> 4	3.50
	C <sub>5</sub> 2	2.00	C <sub>5</sub> 4	2.10
Tea	T <sub>1</sub> 2	5.00	T <sub>1</sub> 4	7.14
	T <sub>2</sub> 2	5.78	T <sub>2</sub> 4	4.50
	T <sub>3</sub> 2	3.18	T <sub>3</sub> 4	6.14
	T <sub>4</sub> 2	6.56	T <sub>4</sub> 4	6.70
	T <sub>5</sub> 2	4.78	T <sub>5</sub> 4	4.60

**Table 3.** Root length of *Vigna radiata* in treatment materials for different durations

Treatment	Average Root Length (cm.)			
	2 hrs. Duration		4 hrs. Duration	
Control	Co2	3.30	Co4	4.12
Coffee	C <sub>1</sub> 2	3.00	C <sub>1</sub> 4	3.30
	C <sub>2</sub> 2	4.50	C <sub>2</sub> 4	2.40
	C <sub>3</sub> 2	2.50	C <sub>3</sub> 4	2.10
	C <sub>4</sub> 2	3.80	C <sub>4</sub> 4	4.50
	C <sub>5</sub> 2	4.30	C <sub>5</sub> 4	3.60
Tea	T <sub>1</sub> 2	4.42	T <sub>1</sub> 4	5.04
	T <sub>2</sub> 2	5.10	T <sub>2</sub> 4	3.60
	T <sub>3</sub> 2	3.76	T <sub>3</sub> 4	4.44
	T <sub>4</sub> 2	5.32	T <sub>4</sub> 4	4.54
	T <sub>5</sub> 2	3.82	T <sub>5</sub> 4	4.50

**Table 5.** Seedling length of *Vigna radiata* in treatment materials for different durations

Treatment	Average Seedling Length (cm.)			
	2 hrs. Duration		4 hrs. Duration	
Control	Co2	6.00	Co4	8.22
Coffee	C <sub>1</sub> 2	6.00	C <sub>1</sub> 4	8.10
	C <sub>2</sub> 2	8.56	C <sub>2</sub> 4	4.90
	C <sub>3</sub> 2	4.90	C <sub>3</sub> 4	4.50
	C <sub>4</sub> 2	7.20	C <sub>4</sub> 4	8.00
	C <sub>5</sub> 2	6.30	C <sub>5</sub> 4	5.70
Tea	T <sub>1</sub> 2	9.42	T <sub>1</sub> 4	12.18
	T <sub>2</sub> 2	10.88	T <sub>2</sub> 4	8.10
	T <sub>3</sub> 2	6.94	T <sub>3</sub> 4	10.58
	T <sub>4</sub> 2	11.88	T <sub>4</sub> 4	11.24
	T <sub>5</sub> 2	8.60	T <sub>5</sub> 4	9.10

factors related to early and maximum germination, better growth and productivity. According to Bewley (1977), “germination can be defined as those events that begin with water uptake by the seed and end with the elongation of the embryonic axis and penetration by the radicle of the structures surrounding the embryo”.

Nowadays both coffee and tea has become the breakfast beverage of practically the whole

population. A cup of coffee or tea can change the mood and a very good stimulant. Absence of these feels the head ache and restlessness in many people.

There are several reports that a wide variety of agents like radiations, chemicals and many environmental mutagens have been found to induce chromosomal aberrations and gene mutations in plant as well as animal materials. Many

**Table 6.** Lateral roots per plant of *Vigna radiata* in treatment materials for different durations

Treatment	Average Number of Lateral Roots per Plant			
	2 hrs. Duration		4 hrs. Duration	
	Co2	4	Co4	5
Control	Co2	4	Co4	5
Coffee	C <sub>1</sub> 2	11	C <sub>1</sub> 4	8
	C <sub>2</sub> 2	7	C <sub>2</sub> 4	5
	C <sub>3</sub> 2	5	C <sub>3</sub> 4	6
	C <sub>4</sub> 2	6	C <sub>4</sub> 4	9
	C <sub>5</sub> 2	9	C <sub>5</sub> 4	8
Tea	T <sub>1</sub> 2	9	T <sub>1</sub> 4	10
	T <sub>2</sub> 2	7	T <sub>2</sub> 4	10
	T <sub>3</sub> 2	8	T <sub>3</sub> 4	9
	T <sub>4</sub> 2	8	T <sub>4</sub> 4	8
	T <sub>5</sub> 2	8	T <sub>5</sub> 4	11

scientists have studied in detail the cellular abnormalities induced by external agents. There are several reports that many plant extracts like that of *Lantana camera* (Susan and Dileep, 1976), extract of *Tylophora indica* (Sagoo *et al*, 1991) etc had mutagenic effects on the root tip cells of *Allium cepa*. Gowrisankar *et al* (1993) had shown that in *Vicia faba* beverages like whisky are capable of inducing a variety of mitotic abnormalities.

The results of the pilot experiment in the present investigation had revealed that the three different pulses – *Cicer arietinum*, *Vigna unguiculata* and *Vigna radiata*, had shown different response to black coffee and black tea. The ecological situations that seeds may encounter have definite effect upon the expression of their viability, potential and resultant seedling growth and development.

In many instances, it is observed that viable seeds do not germinate in spite of provision of favourable and suitable conditions for normal germination. From the pilot experiment, *Vigna radiata* had shown very good response than the other two pulses with the treatment of black coffee and black tea. According to Mayer and Poljakoff-Mayber (1963) the dormancy maybe induced in seeds if environmental conditions are unfavourable.

**Table 7.** Vigour index of *Vigna radiata* in treatment materials for different durations

Treatment	Vigour Index			
	2 hrs. Duration		4 hrs. Duration	
Control	Co2	480	Co4	699
Coffee	C <sub>1</sub> 2	600	C <sub>1</sub> 4	810
	C <sub>2</sub> 2	856	C <sub>2</sub> 4	490
	C <sub>3</sub> 2	490	C <sub>3</sub> 4	450
	C <sub>4</sub> 2	720	C <sub>4</sub> 4	800
	C <sub>5</sub> 2	630	C <sub>5</sub> 4	570
Tea	T <sub>1</sub> 2	942	T <sub>1</sub> 4	1218
	T <sub>2</sub> 2	1088	T <sub>2</sub> 4	810
	T <sub>3</sub> 2	694	T <sub>3</sub> 4	1058
	T <sub>4</sub> 2	1188	T <sub>4</sub> 4	1124
	T <sub>5</sub> 2	860	T <sub>5</sub> 4	910

Further investigation conducted after the selection of test material with different concentrations of treatment materials and durations reveals that the black tea supports the germination of seeds more than black coffee. Heydacker (1973) recognized seed germination as the process of activation of a resting embryo. According to him, physiologically and strictly speaking, germination ends with the first manifestational growth even before the seed coat is ruptured. In germination experiments, the radicle emergence is often used as the end point.

In the present investigation, low concentrations of black coffee induce the germination more than the higher concentration, compared to black tea. It is supported by the studies conducted in mung bean using low concentrations of caffeine, less than 1,000 micrometers. The low concentration affected the rooting of the mung bean by causing a stunting affect. Roots grew, but they did not produce the normal range of growth. When larger concentrations, more than 1,000 micrometers, of caffeine were applied to the mung bean seed, the roots were reduced further. When 2,000 micrometers of caffeine was added to soil, the roots did not grow all (<http://www.ehow.com>).

In this investigation, the treatments of black coffee and black tea had shown significant result in

root length. Similar results were obtained by Abbas and Abutabikh (1975) that GA<sub>3</sub> treatment increased the root length in cowpea. This may be due to the cell elongation and loosening of the cell resulting in the increasing root length.

In black tea, treated had shown significant increase in their shoot length over the control. This may be due to increased cell division. This is in confirmation that bioregulator was helpful in the transformation of dwarf plants into tall ones by increased stem elongation (Chinoy, 1968). Whole plant length also showed a significant effect when treated with black tea and black coffee over the control. Coffee contains ingredients like potassium and phosphorous, which are known to enhance plant growth.

More number of lateral roots was observed in black tea treatment with higher duration. Black tea treatment had significant impact on vigour index also. According to Woodstock (1973), seed vigour is the condition of active good health and natural robustness in seeds which upon planting permits germination to proceed rapidly and to completion under a wide range of environmental conditions.

## Conclusion

The black tea was capable of inducing germination compared to the black coffee and the control. Among the two durations tried, four hours treatment had shown the maximum response than the two hours treatment. Sprouts have long been famous as health food. Recent research shows that in addition to being a superb source of nutrients, sprouts also have curative properties. Green gram, apart from being a good source of protein also contains useful amounts of fibre, potassium, and B-vitamins. They contain low levels of fat, cholesterol and sodium. It is useful for those of us who want to increase their alertness and mental abilities. Phosphorous is also necessary for healthy bones and teeth, a fact which makes sprouted seeds desirable for babies and children.

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