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## **A STUDY OF THERAPEUTIC EFFECTS OF *DARK CHOCOLATE* ON BLOOD PRESSURE**

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### **ABSTRACT**

Hypertension is a common disease in Indian population. Control of hypertension is important as uncontrolled hypertension is associated with the significant morbidity. Dark chocolate may have some beneficial effect in control of blood pressure. The aim of the study is to know whether dark chocolate are actually beneficial in disease like hypertension & can be used as therapeutic nutraceuticals. A longitudinal study done at JK hospital, Bhopal done six groups over six months. Group A,B and C consists of 20 normotensive subjects each (10 male and 10 female). Group A received placebo. Group B received 2 bars of chocolate per week. Group C received 4 bars of chocolate per week. Group D,E and F consists of 20 hypertensive subjects each. Group D received antihypertensive medication only (Enalapril). Group E received 2 bars of chocolate per week and antihypertensive medication (ACE inhibitor). Group F received 4 bars of chocolate per week and antihypertensive medication (ACE inhibitor). BP was recorded at the interval three month in each group and it was compared. The data was analyzed using Graph pad prism5 software. Unaired t test was applied for anthropometric characteristics of the various groups. One way anova test was used to compare blood pressure change in various groups. The Results shows a significant reduction in systolic as well as diastolic blood pressure was seen males as well as in females in the group C i.e. normotensive subjects who received 4 bars of chocolate per week. It was concluded that the dark chocolate exert some protective effect on blood pressure control in normotensive subjects. Further studies are recommended with large sample size.

**Keywords:** Dark chocolate, Hypertension, JNC-7 classification.

### **INTRODUCTION**

Hypertension is a common disease occurring in Indian population which is according to JNC 7 is classified as prehypertension, stage 1 and stage 2 hypertension [1]. The link between blood pressure and cocoa consumption was first identified in 1944 by researchers who were looking at levels of blood pressure in Kuna Indians – a tribe living on an island off the coast of Panama. They found that tribe members who continued to live on the island, who drinks cocoa, had lower levels of blood pressure compared

with those who had migrated to mainland Panama, where cocoa consumption is much less common [2]. It has been found that cocoa improve nitric oxide availability, thus it protect vascular endothelium. This effect is seen due to presence of flavonoids.

Many drugs are available for the treatment of hypertension, and their efficacy has been already proved. These are very effective in the treatment of hypertension. Numerous studies had been done in the foreign countries where dark chocolate was found to be effective in lowering blood pressure [2-6]. Now the question arises whether these chocolate can be used as nutraceuticals for the treatment of hypertension. Or these chocolate should be used only for preventive point of view. With this study, we would come to know whether addition of chocolate to antihypertensive drug Enalapril leads to any further improvement in blood

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pressure control and also we will what is the effect of dark chocolate in normotensive patients.

From this study we would know whether chocolates which are considered just as confectionary (most of which are considered harmful to health, lead to diseases like obesity & precipitate diabetes) are actually beneficial in disease like hypertension & can be used as therapeutic nutraceuticals.

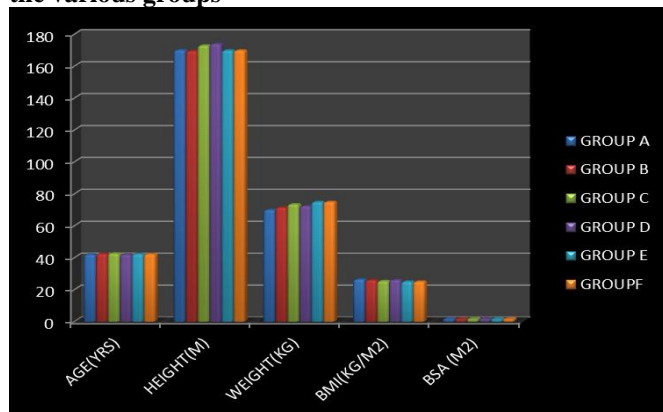
### Subjects and Methods

This was the longitudinal study done at JK hospital, Bhopal. This study was done on the five groups in the age group of 40 to 45 years over the period of 6 months. Each group consists of 10 male and 10 female. Each group received intervention for 6 months. Group A consists of 20 normotensive subjects who received neither chocolate nor any antihypertensive. They received placebo in form of multivitamin tablet. Group B consists of 20 normotensive subjects (10 male and 10 female) who received 2 bars of chocolate per week. Group C consists of 20 normotensive subjects who received 4 bars of chocolate per week. Group D consists of 20 hypertensive subjects who received antihypertensive medication. Group E consists of 20 hypertensive subjects who received 2 bars of chocolate per week and antihypertensive medication (ACE inhibitor-Enalapril 5 mg). Group F consists of 20 hypertensive subjects who received 4 bars of chocolate per week and antihypertensive medication (ACE inhibitor). Hypertensive subject which were included in this study were freshly diagnosed cases prehypertension whose BP measured under ideal condition was 120-139/80-89 mm Hg. This was according to JNC 7 classification [1].

BP was measured in right arm supine position with the adult size cuff early morning before starting any physical activity by the standard procedure. Instrument which was used for this study was Diamond, Industrial electronic and allied Products, Pune. BP was recorded at the interval three month in each group.

Dark chocolate bar which were distributed of Cadbury India Company, Rich Cocoa variant (80gm). This

**Figure 1. Anthropometric characteristics of the male in the various groups**



No significant difference p value >0.05

was given by the author at their residence and they were taking the chocolate in front of the author.

All the hypertensive patients who were recruited in the study were taking Enalapril 5 mg. These patients were recruited from Medicine OPD of JK hospital. Their BP monitoring was done every 15 days. If any patient whose BP was not controlled with this medication was excluded from this study. Enquiry about their life style was made. Patient with the unhealthy lifestyle were excluded from the study. The entire subject had undergone general and systemic examination before inclusion in the study and also in follow up.

### Inclusion Criteria

- 1) Patient with the essential hypertension.
- 2) Patient taking Enalapril 5 mg
- 3) Patient in the age group 40 to 45 years.
- 4) Patient in prehypertension stage (JNC7 classification).

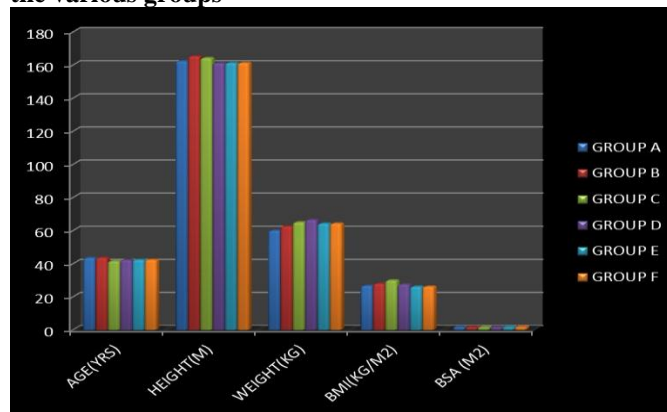
### Exclusion Criteria

- 1) Patient with stage I and stage 2 hypertension (JNC7 classification).
- 2) Pregnancy
- 3) Diabetic
- 4) Patient with the history smoking, alcohol and tobacco chewer.
- 5) Hypertension with the known cause.
- 6) Patient taking other drug and higher dose.

Ethical clearance was obtained from institution ethics committee.

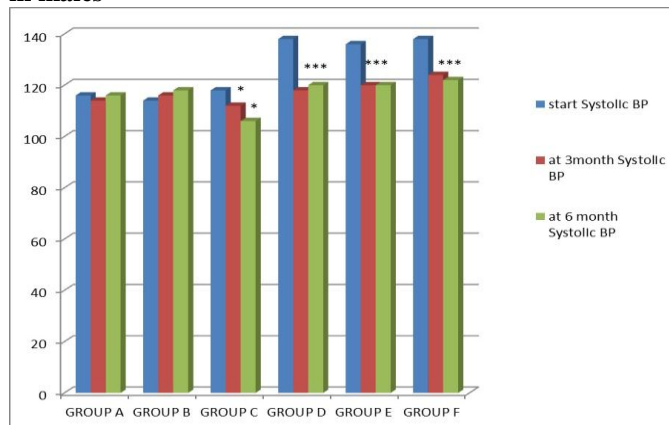
Then the data of the observation for all parameters were statistically analyzed by calculating mean and standard deviation. The data was analyzed using Graph pad prism5 software. Unaired t test was applied for anthropometric characteristics of the various groups. One way ANOVA test was used to see blood pressure change and p value <0.05 was considered as statistically significant.

**Figure 2. Anthropometric characteristics of the female in the various groups**



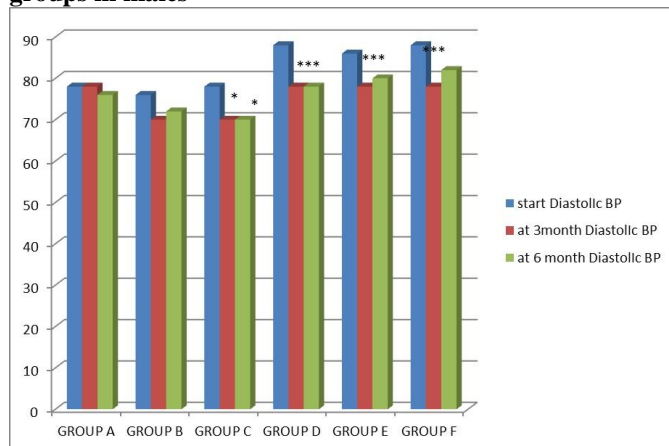
No significant difference p value >0.05

**Figure 3. Systolic blood pressure change in various group in males**



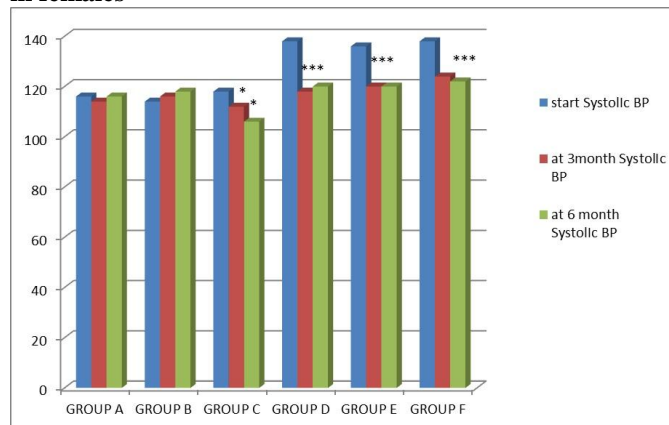
\*: p<0.05, \*\*\*: p<0.001

**Figure 5. Diastolic blood pressure change in various groups in males**



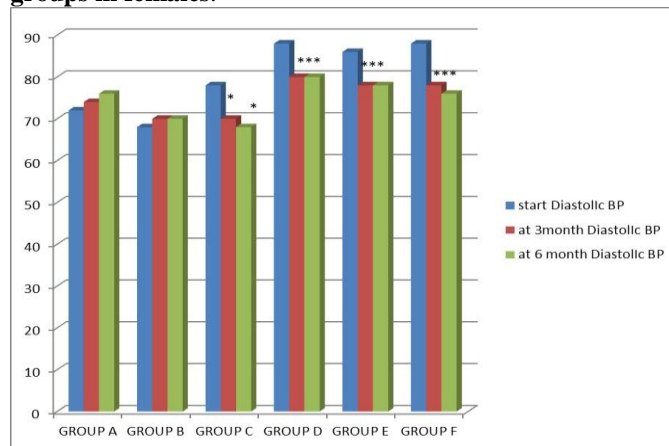
\*: p<0.05, \*\*\*: p<0.001

**Figure 4. Systolic blood pressure change in various group in females**



\*: p<0.05, \*\*\*: p<0.001

**Figure 6. Diastolic blood pressure change in various groups in females.**



\*: p<0.05, \*\*\*: p<0.001

**RESULTS**

Anthropometric characteristics of subjects enrolled in the study are shown in figure 1 and 1. Mean age of the male and female enrolled in the study were 42.56±2.2 yrs and 43.56±1.2 yrs respectively. There were no significant difference anthropometric characteristics between all groups.

Significance reduction in systolic as well as diastolic blood pressure was seen males as well as in females in the group C i.e. normotensive subjects who received 4 bars of chocolate per week (p<0.05). For this significant reduction, three months was enough. Very significant reduction was seen group D,E and F (p<0.001)in both males and females however when inter comparison between these group were made no significant difference was seen. (Figure. 3, 4, 5, and 6)

**DISCUSSION**

We had done this study to know whether chocolates are considered just as confectionary, are actually beneficial in disease like hypertension. Significance

reduction in systolic as well as diastolic blood pressure was seen males as well as in females in the normotensive subjects who received 4 bars of chocolate per week. Very significant reduction was seen group D,E and F who were taking Enalapril 5 mg, however when inter comparison between these group were made no significant difference was seen. So dark chocolate may not be used for therapeutic purpose as it does not add to any improvement in the blood pressure control with Enalapril use. However it does decrease blood pressure in normotensive person who are not taking any antihypertensive, thus their use may be promoted when it comes to blood pressure control from preventive point of view.

Novelty of this study is that we had tried to match the factors like age and anthropometric parameters between various groups. Reason behind this was these are the important factors which act as chief determinant in the control blood pressure. We had also kept the similar dosage of drug as matching factor. From ethical point view, patient with the prehypertension stage had to be started on treatment. Hence these patients were started on treatment

and they were given the chocolate just to see whether there is any additive effect of the chocolate.

Many studies have been in the foreign country. Author reported mixed result in their study. Ried K et al [7] had studied the effect of dark chocolate or tomato extract in prehypertensive patient. He reported the significant improvement in the blood pressure. Desch S et al [5] and Taubert et al [6] had done the meta analysis and found a significant reduction in blood pressure with the use of chocolate. Some author found significant reduction in blood pressure in prehypertension stage but not in normotensive patient which is contradictory to our finding [8,9]. Reason behind this may be that beneficial effect of chocolate is not apparent as a result of Enalapril use.

Why dark chocolate consumption should produce reduction blood pressure? Cocoa is one of the most important component of dark chocolate. It has been observed that it protect the vascular endothelium by augmenting NO availability and thereby improving endothelium-dependent vasorelaxation [10,11]. It had also shown favourable metabolic effect which may further leads to control blood pressure. The link between blood pressure and cocoa consumption was first identified in 1944 by researchers who were looking at levels of blood pressure in Kuna Indians – a tribe living on an island off the coast of Panama. They found that tribe members who continued to live on the island, who drinks cocoa had lower levels of blood pressure compared with those who had migrated to mainland Panama, where cocoa consumption is much less common [2]. It has been found that cocoa improve nitric oxide availability, thus it protect vascular endothelium. This effect is seen due to presence of flavonoids. Recent studies showed that flavanols, a subclass of flavonoids that is present in natural cocoa beans, increase NO production by cultured human vascular endothelial cells and improve endothelium-dependent vasorelaxation in finger and brachial arteries of healthy humans [10,11]. Oxidative stress, inflammation, and endothelial function define three biological mechanisms that have shown sensitivity to chocolate. BP control may be as a result favourable effect on these three mechanisms [4]

Now the question arises whether it should be used as an intervention. Studies done in foreign country are in favour of its use as a nutraceutical. Whether use it as an

intervention will depend on certain factors like alternative treatment, cost factor, patient compliance, side effect, efficacy and potency of this nutraceutical against alternative treatment. Dark chocolate may have good patient compliance but for this it has to be mixed with the sugar. When the sugar is added, metabolic side effect will increase and it could not be used in patient with certain metabolic disorder like diabetes mellitus. Cost of the chocolate is another issue. In India, most of the people cannot afford to use it on daily or twice week basis. Cost factor can be taken care of by the government but for this we have to give the solid evidence of its benefit so that government can take the step to decrease its cost. For it, we recommend numerous studies with the large sample size. Alternative treatments available and used mainly are antihypertensive drugs whose efficacy, potency and patient compliance are tested. These will definitely remain the first choice of treatment. In the literature, we had come across the studies where tomato and garlic extract has been used as treatment and are found to be effective [12,13]. According to us, these should tested along with the dark chocolate as their use is economical and chances of side effect will be less as we don't have to add anything to them and these are the component of our routine meal.

## CONCLUSION

To conclude, Dark chocolate exert some protective effect on blood pressure control in normotensive subjects. Addition of chocolate to antihypertensive drug Enalapril does not lead to any further improvement in blood pressure control. We recommend further studies with the large sample size to see the effect of the dark chocolate on blood pressure in normotensive as well as hypertensive patient. Also effect of tomato and garlic extract should be studied.

## LIMITATION OF THE STUDY

In our study, subject on Enalapril were taken. We should have done this study pre-hypertensive group not taking any treatment, however for ethical reason it was not possible. We could have included other group taking treatment other than Enalapril. In this study, detailed enquiry of lifestyle was done and these are the important determinant of blood pressure.

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