Consumption of dark chocolate reduced lipoprotein cardiovascular risk factors in an Ivorian population

Marie-Laure Hauhouot-Attoungbré[1,2], Sagou Eric Yayo[1], Carine Yao[1], Angele Aké-Edjeme[1], Hugues Ahibo[1], Houphouet Felix Yapi[1], Dagui Monnet[1]

[1]Biochemistry Laboratory, Falculty of Pharmacy, Abidjan, Côte d'Ivoire

[2]Biology Laboratory, Institute of Cardiology of Abidjan, Côte d'Ivoire

ABSTRACT

A number of studies have demonstrated the beneficial effect of dark chocolate consumption on cardiovascular risk factors. However, no such studies exist for Ivorian populations. Here we carried out a prospective study conducted over a period of 30 days, involving 111 people aged between 19 and 60 years. Each subject was asked to consume 20 g of dark chocolate, containing 70% of cocoa, per day for 30 days. Weight and blood pressure of subjects were recorded before and after eating dark chocolate. Blood samples in fasting state were taken before and after the conclusion of the study to measure glucose, total, HDL and LDL cholesterol and triglycerides. Eating dark chocolate had no effect on weight and blood pressure, but it resulted in a significant decrease ($P < 0.05$) of total and LDL-cholesterol concentrations, and in a significant increase ($P < 0.05$) of HDL-cholesterol. These results suggest that a regular consumption of dark chocolate may have a beneficial effect on lipoprotein cardiovascular risk factors.

INTRODUCTION

Côte d'Ivoire is the world's leading producer of cocoa, the basis of chocolate (1), but, paradoxically, it seems that consumption of chocolate is not part of the eating habits for the majority of Ivoirians.

Many studies performed in Western Countries have demonstrated the benefits of consumption of flavonoid-rich chocolate (dark chocolate) on health in general. There is evidence that dark chocolate consumption has beneficial effects on cardiovascular disease, platelet function, lipid metabolism and insulin resistance in type II diabetes (2-9). Studies revealing possible benefits of dark chocolate consumption to human health and for cardiovascular disease, in particular, do not exist for Côte d'Ivoire population. On the other hand, previous studies have established that Ivorians show lipoprotein (a) concentrations much higher than those reported in Caucasian populations regardless of the measurement method (10). In this aspect, Ivoirians are thus at higher risk of developing cardiovascular disease.

The aim of our study was to investigate the effect of eating dark chocolate on cardiovascular risk factors in the Ivorian population. The considered parameters were blood pressure (BP), weight and body mass index (BMI), and biochemical variables (blood glucose, total, LDL and HDL cholesterol, and triglycerides), measured before and after a period of regular intake of dark chocolate.

MATERIAL AND METHODS

Subjects

This prospective study lasted for a period of 30 days, from November to December 2008. 111 workers of a cocoa paste factory volunteered for the study. The location was selected because an en-suite canteen allowed a careful monitoring of the food intake. Each subject signed a consent form after oral information. Exclusion criteria included self declaration of diabetes and not trustable subjects.

Protocol

Before the commencement of the study (D0) sociodemographic and clinical data were recorded for each subject (age, sex, blood pressure, height, and body weight). Blood samples were collected in the fasting state to measure glucose, total, HDL and LDL cholesterol and triglycerides on a multiparametric biochemistry analyzer (Lysa XS Hycel 9), using conventional enzymatic methods.

During the study, each subject consumed 20 g per day of dark chocolate containing 70% of cocoa, for 30 days. This consumption was monitored and recorded daily. At the end of the study (D30), all participants were reexamined by collecting clinical data and biochemical parameters were measured again.

Correspondence to: M.L. Hauhouot-Attoungbré, Laboratoire de Biochimie de l'UFR Pharmacie, BP V34 Abidjan, Côte d'Ivoire. Tel. 00225 07029989, Fax 0022522440670, E-mail mlattoungbre@hotmail.com

Ricevuto: 30.11.2010 Revisionato: 31.01.2011 Accettato: 02.02.2011

Statistics

The statistical analysis of data was done using the software Excel 2007 and Epi Info version 6.0. The comparison of means was performed by the Student test. The test was considered significant for P value <0.05.

RESULTS

The participants were predominantly males (78 men, 33 women). The youngest subject was 19 years old and the oldest 60 years, with an mean age of 36 years. BMI, systolic (SBP) and diastolic blood pressure (DBP) did not change significantly after consumption of dark chocolate (P >0.05) (Table 1).

The biochemical parameters are shown in Table 2; while glucose concentrations remained unchanged, total cholesterol, LDL cholesterol and triglyceride decreased significantly after the consumption of dark chocolate. On the other hand, HDL cholesterol increased significantly after consumption of dark chocolate resulting in a decrease of the atherogenic index (the ratio of total cholesterol to HDL-cholesterol).

DISCUSSION

The obtained results demonstrate that eating dark chocolate does not significantly affect BMI. Similar results were found in a study by Suisse researchers in 2010 that showed that food rich in flavonoids does not increase the BMI of subjects (11). Our results also showed that eating dark chocolate has no significant effect on BP both systolic and diastolic. This is partially in contrast with other studies (4-7, 12), demonstrating that regular consumption of dark chocolate significantly lowers BP in hypertensive patients. In the study by Taubert et al. (12), the prevalence of hypertension decreased from 86% to 68% after daily consumption of two cubes of dark chocolate for two years. Our study, however, was not aimed to include hypertensive subjects.

The results obtained in our study showed that there were no differences between blood glucose concentrations before and after consumption of chocolate. Indeed, some Authors (6, 7) have shown that the dark chocolate has a very low glycemic index and so it would not allow a significant increase in blood sugar. Furthermore, these studies also showed that dark chocolate has rather a beneficial effect in type 2 diabetes mellitus patients by improving the response of body cells to insulin.

We observed statistical differences in lipid values measured before and after consumption of dark chocolate. Similar results were found in other studies demonstrating that regular consumption of dark chocolate or cocoa powder results in an increase of HDL cholesterol and in a reduction of total and LDL cholesterol (8, 13, 14). The beneficial effects of dark chocolate are also explained by the antioxidant effect of flavonoids, preventing LDL oxidation. The observed effect on HDL cholesterol was also obtained by Wan and Vinson on 23 subjects who consumed 38 g per day of dark chocolate for 4 weeks (9). Finally, for triglyceride the significant difference observed before and after consumption of dark chocolate was not found in previous studies. So, our study is a very original one in this aspect.

In summary, the atherogenic (total and LDL cholesterol and triglycerides) and the antiatherogenic (HDL cholesterol) lipid parameters change favorably after consumption of dark chocolate. The consumption of

Table 1
Blood pressure and body mass index (BMI) before and after eating of dark chocolate

	Before (D0)	After (D30)	
	Mean ± SD	Mean ± SD	P
Systolic blood pressure, mmHg	124.5 ± 18.1	126 ± 16.1	0.06
Diastolic blood pressure, mmHg	79 ± 11.4	81.4 ± 11.4	0.40
BMI, kg/m^2	23.4 ± 3.8	23.8 ± 3.5	0.43

Table 2
Biochemical parameters of studied subjects before and after eating of dark chocolate

	Before (D0)	After (D30)	
	Mean ± SD	Mean ± SD	P
S-Glucose (mmol/L)	5.05 ± 0.72	5.11 ± 0.72	0.53
S-Total cholesterol (mmol/L)	5.29 ± 1.24	4.67 ± 1.24	0.000
S-HDL-cholesterol (mmol/L)	1.22 ± 0.39	1.37 ± 0.39	0.005
S-LDL-cholesterol (mmol/L)	3.67 ± 1.21	2.97 ± 1.06	0.000
S-Triglycerides (mmol/L)	0.86 ± 0.58	0.73 ± 0.28	0.034
Total cholesterol/HDL-cholesterol ratio	4.33 ± 3.17	3.40 ± 3.17	0.030

dark chocolate, as part of a balanced diet, might be a further weapon to fight against cardiovascular disease.

REFERENCES

1. Direction générale de l'Economie. Ministère de l'Economie et des Finances de la république de Côte d'Ivoire. La Côte d'Ivoire en chiffres, dialogue production, Abidjan 2007;72-3.
2. Maron DJ. Flavonoids for reduction of artherosclerotic risk. Curr Atheroscler Rep 2004;6:73-8.
3. Vita JA. Polyphenols and cardiovascular disease: effects on endothelial and platelet function. Am J Clin Nutr 2005;81(suppl 1):292S-7S.
4. Taubert D, Bekerls R, Roesen R, et al. Chocolate and blood pressure in elderly individuals with isolated systolic hypertension. JAMA 2003;290:1029-30.
5. Buijsse B, Feskens EJ, Kok FJ, et al. Cocoa intake, blood pressure, and cardiovascular mortality: the Zutphen Elderly Study. Arch Intern Med 2006;166:411-7.
6. Grassi D, Necozione S, Lippi C. Cocoa reduces blood pressure and insulin resistance and improves endothelium-dependent vasodilation in hypertensives. Hypertension 2005;46:398-405.
7. Grassi D, Lippi C. Short-term administration of dark chocolate is followed by a significant increase in insulin sensitivity and a decrease in blood pressure in healthy persons. Am J Clin Nutr 2005;81:611-4.
8. Mathur S, Devaraj S, Grundy SM, et al. Cocoa products decrease low density lipoprotein oxidative susceptibility but do not affect biomarkers of inflammation in humans. J Nutr 2002;132:3663-7.
9. Wan Y, Vinson JA. Effects of cocoa powder and dark chocolate on LDL oxidative susceptibility and prostaglandin concentrations in humans. Am J Clin Nutr 2001;4:596-602.
10. Edjeme-Aké, Garnotel R, Angles CE, et al. Immunoquantification of serum lipoprotein(a) in healthy Ivorian subject: a comparative evaluation of two methods. Ann Biol Clin (Paris) 2007;65:629-35.
11. Corti R, Perdrix J, Flammer AJ, et al. Dark or white chocolate? Cocoa and cardiovascular health. Rev Med Suisse 2010;6:499-504.
12. Taubert D, Schoming E. Effects of low habitual cocoa intake on blood pressure and bioactive nitric oxide. JAMA 2007;298:49-60.
13. Rudkowska I, Jones PJ. Functional foods for the prevention and treatment of cardiovascular diseases: cholesterol and beyond. Expert Rev Cardiovasc Ther 2007;5:477-90.
14. Mursu J, Voutilainen S, Nurmi T, et al. Dark chocolate consumption increases HDL cholesterol concentration and chocolate fatty acids may inhibit lipid peroxidation in healthy humans. Free Radic Biol Med 2004;37:1351-9.