Universiti Putra Malaysia
Berilmu Berbakti | *With Knowledge We Serve*

EXPLORING OF MALAYSIAN UNDERUTILISED 'SUPER' FRUITS FOR HUMAN NUTRITION AND SUSTAINABLE DIETS

AMIN ISMAIL, Ph.D.
Professor

Department of Nutrition and Dietetics
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia (UPM)
Selangor, Malaysia


අපේ පළතුරු
Our Fruits


අපේ එළවළු
Our Vegetables

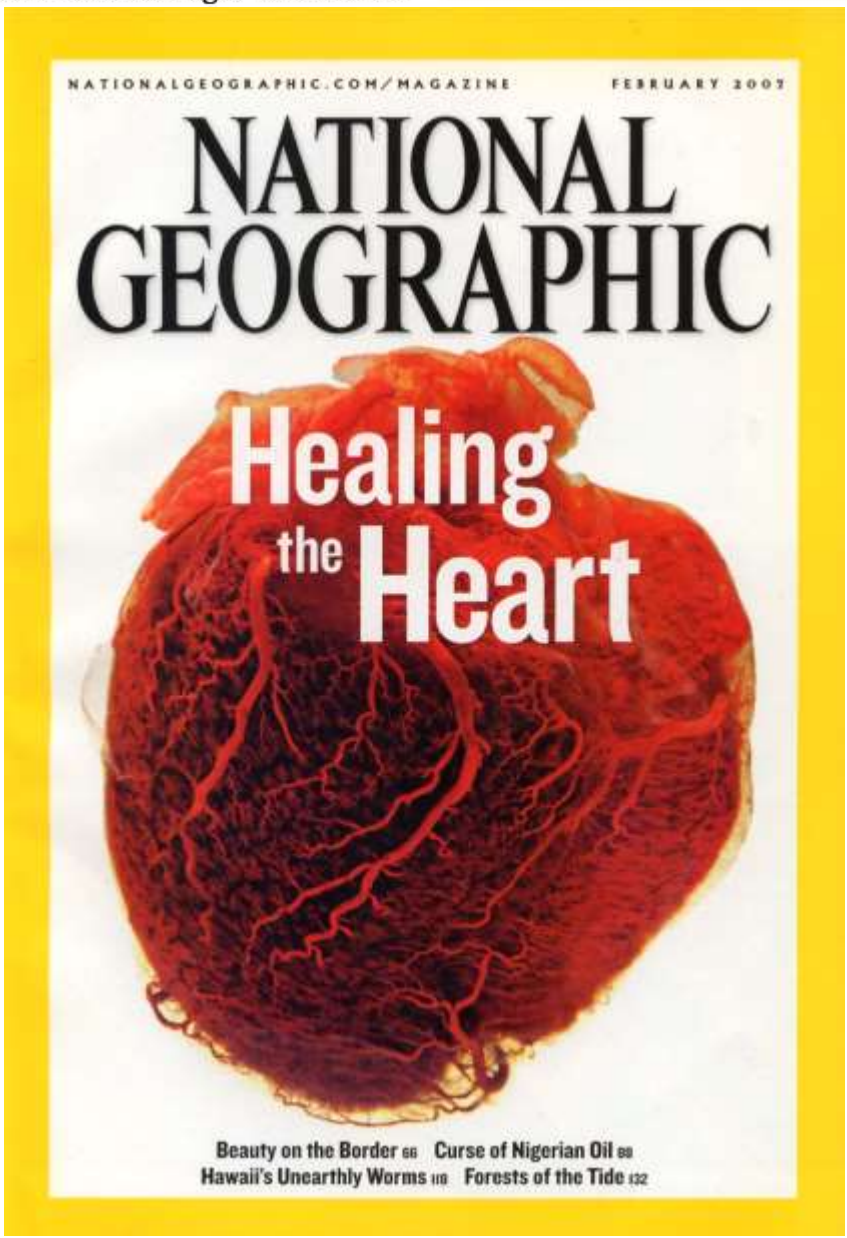
Outline of Presentation

- Introduction to underutilized fruits
- Nutritional composition of Dabai & Bambangan
- Health promoting properties
- Concluding remarks

- Fruits - "food of the god"
- Inverse correlation between the incidence of chronic diseases and fruits consumption
- Insufficient consumption of fruits & vegetables is one of the ten leading global disease risk factors – WHO (2002)
- Many studies have been focused on commercial & export fruits

Several studies have reported that dietary fiber and antioxidants are two dietary factors involved cardiovascular disease **(Arts and Hollman, 2005; He *et al*., 2007; Pérez-Jiménez *et al*., 2008; Larsson *et al*., 2009)**.

Fruits and vegetables have received much attention as a source of biologically active substances because of their antioxidant and dietary fiber properties **(Dillard and German, 2000; Larsson *et al*., 2009).**



NUTRITION AND BIODIVERSITY

AGRICULTURAL BIODIVERSITY

UNDERUTILIZED PLANT SPECIES: FRUITS & VEGETABLES

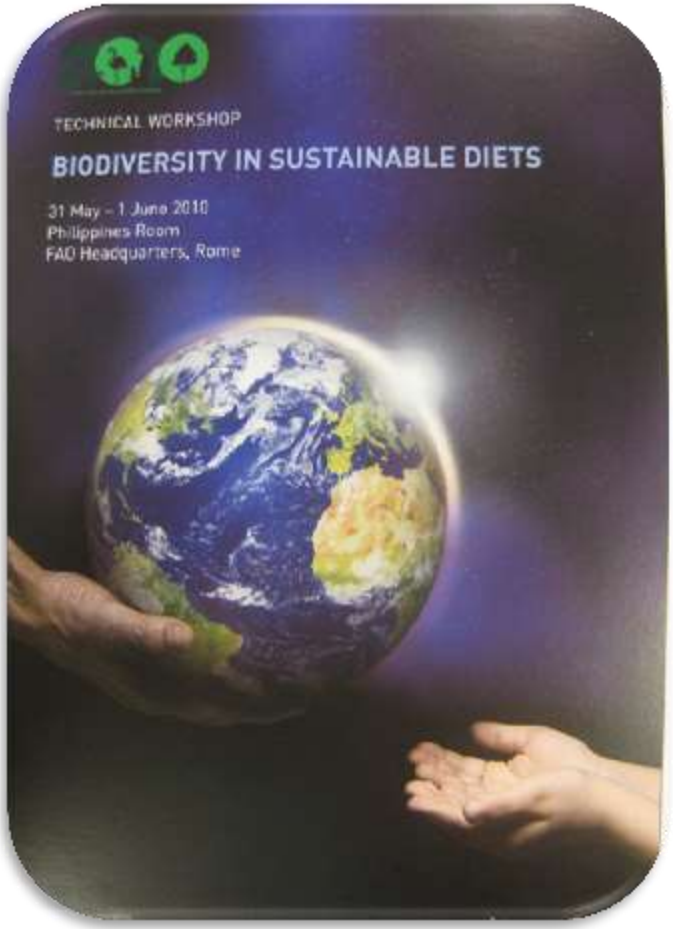
Terms:
indigenous, rare, exotic, wild, under-exploited

➢**Role of biodiversity**: source of foods, income for rural people for sustaining and strengthening food, nutrition, health and livelihood security

➢Contribute to → realization of **MDGs,** to halve the proportion of people who suffer from hunger and ensure environmental sustainability (FAO, 2010) .

Species with underexploited potential to contribute in food security, health and nutrition, income generation and environmental services (GFU, 2007)


The Global Facilitation Unit for Underutilized Species
enabling deployment of underutilized species


TECHNICAL WORKSHOP
BIODIVERSITY IN SUSTAINABLE DIETS
31 May – 1 June 2010
Philippines Room
FAO Headquarters, Rome


Approaches and Decision Steps for the Promotion and Development of Underutilized Plant Species
Agricultural Biodiversity and Elimination of Hunger and Poverty
The Global Facilitation Unit for Underutilized Species


Food made from underutilized plants, such as minor millets, is increasingly popular amongst the younger generation.

- In Malaysia - > 370 species of fruits
- Commercial fruits – papaya, mango, star fruits, pineapple, guava
- Rare fruits
- Indigenous fruits
- Wild fruits
- Exotic fruits

Underutilized Fruits (rare, indigenous, wild, exotic; long history of consumption & used by the locals)

Asam paya

Durian Kuning

Dabai

Green Longan

Tampoi

Bambangan

Cherry
(*Malpighia punicifolia*)

'Kerandang'
(*Carissa congesta*)

'Rokam manis'
(*Flacourtia rukam*)

'Kuini'
(*Mangifera odorata*)

'Asam gelugor'

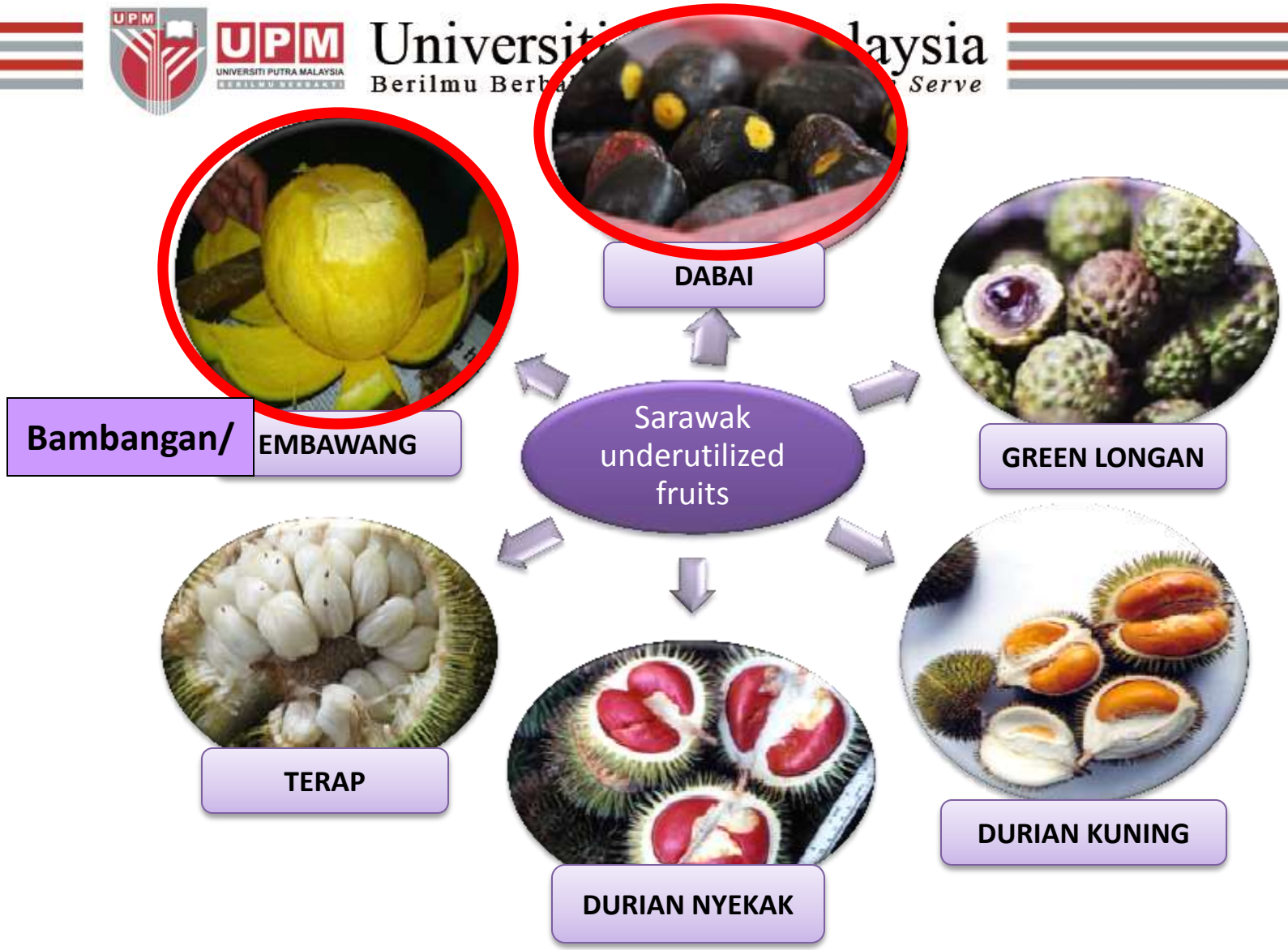
'Bidara'
(*Ziziphus mauritania*)

'Jambu bol'
(*Syzygium malaccense*)

'Kuning telur'
(*Pouteria campechiana*)

'Jambu susu'
(*Syzygium jambos*)

Underutilised fruits of Sarawak



***Sarawak* State Department of Agriculture has identified**

6 underutilized fruits → Economic Fruit Crop

Journal of Food Composition and Analysis 22 (2009) 388–393

Contents lists available at ScienceDirect

Journal of Food Composition and Analysis

journal homepage: www.elsevier.com/locate/jfca

Original Article

Antioxidant capacity and total phenolic content of Malaysian underutilized fruits

Emmy Hainida Khairul Ikram [a], Khoo Hock Eng [a], Abbe
Amin Ismail [a,*], Salma Idris [b], Azrina Azlan [a], Halimatul
Norzatol Akmar Mat Diton [a], Ruzaidi Azli Mohd Mokht

[a] Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Pu
[b] Botany Division, Strategic Resource Research Center, Malaysian Agricultural Research and De

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

ARTICLE

pubs.acs.org/JAI

Functional Properties and Characterization of Dietary Fiber from *Mangifera pajang* Kort. Fruit Pulp

Sadeq Hassan Al-Sheraji,[†,⊥] Amin Ismail,[*,†,‖] Mohd Yazid Manap,[‡] Shuhaimi Mustafa,[§,‖] Rokiah Mohd Yusof,[†] and Fouad Abdulrahman Hassan[†,⊥]

[†]Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, [‡]Department of Food Technology, Faculty of Foo Science and Technology, [§]Department of Microbiology, Faculty of Biotechnology and Biomolecular Sciences, [‖]Laboratory Analysis ar Authentications, Halal Products Research Institutes, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

[⊥]Department of Food Science, Faculty of Agriculture, Ibb University, Yemen

Food Chemistry 126 (2011) 283–288

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Characterisation of fibre-rich powder and antioxidant capacity of *Mangifera pajang* K. fruit peels

Fouad Abdulrahman Hassan [a,b], Amin Ismail [a,c,*], Azizah Abdul Hamid [d], Azrina Azlan [a], Sadeq Hasan Al-sheraji [a,b]

[a] Department of Nutrition and Dietetics, Faculty of Medicine and Health Science, Universiti Putra Malaysia, UPM Serdang 43400, Selangor, Malaysi
[b] Department of Food Science, Faculty of Agriculture, Ibb University, Yemen
[c] Laboratory Analysis and Authentication, Halal Products Research Institute, Universiti Putra Malaysia, UPM Serdang 43400, Selangor, Malaysia
[d] Department of Food Science, Faculty of Food Science and Technology, Universiti Putra Malaysia, UPM Serdang 43400, Selangor, Malaysia

ARTICLE INFO

Article history:

ABSTRACT

The composition of bambangan peel dietary fibre (DF) and several propert

Food Chemistry 128 (2011) 1121–1127

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Analytical Methods

Response surface optimisation for the extraction of phenolic compounds and antioxidant capacities of underutilised *Mangifera pajang* Kosterm. peels

K. Nagendra Prasad [a,1], Fouad Abdulrahman Hassan [a,1], Bao Yang [b], Kin Weng Kong [a,c], Ramakrishnan Nagasundara Ramanan [d], Azrina Azlan [a], Amin Ismail [a,e,*]

[a] Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[b] South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, PR China
[c] Department of Molecular Medicine, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia
[d] Chemical and Sustainable Process Engineering Research Group, School of Engineering, Monash University, 46150 Bandar Sunway, Selangor, Malaysia
[e] Laboratory of Analysis and Authentication, Halal Products Research Institute, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

ARTICLE INFO

ABSTRACT

Bambangan and Dabai

- Sarawak; **rich in biodiversity**
- 75 species of indigenous tree from 18 families with NOBLE quality fruits (Lau, 2009)

Canarium odontophyllum Miq.

Family: Burseraceae

Local name: Dabai/Sibu olive

Dabai fruits

- rarely eaten, unfamiliar and unknown elsewhere apart from Sarawak
- seasonal in nature and appreciated as an exotic fruit
- whole ripe fruit is soaked in warm water for 3-5 minutes to soften the pulp and eaten
- sometimes it is consumed seasoned with sugar, salt, pepper or sauce
- the stony hard seed is discarded

Dabai fruits

Dabai fruits- physical properties

Property	Mean (± Standard deviation, SD)	
	Bigger size	Smaller size
Length (cm)	4.10 (± 0.11)	3.74 (± 0.08)
Width (cm)	2.79 (± 0.13)	2.40 (± 0.07)
Mass (g)	18.28 (± 1.59)	12.73 (± 0.69)
Mass (g) of fraction:		
Skin	1.02 (± 0.19)	0.86 (± ND)
Flesh	11.22 (± 0.93)	7.81 (± ND)
Kernel	6.79 (± 0.81)	5.84 (± ND)
Thickness (cm)	0.5 (± 0.0)	0.4 (± 0.0)
Sphericity index, S_c (%)	43.62 (± 0.76)	41.28 (± 0.69)
Aspect ratio, R_a (%)	67.37 (± 4.32)	65.79 (± 2.26)

-*ND = not determined

Dabai fruits


VIETNAM
Gulf of Thailand
THAILAND
SPRATLY ISLANDS
PHILIPPINES
Sulu Sea
Kudat
Kota Kinabalu
Gunung Kinabalu
Sandakan
Sabah
Kota Baharu
Kuala Terengganu
South China Sea
Pulau Pinang
George Town
Taiping
Ipoh
Lumut
KUALA LUMPUR
Kuantan
Strait of Malacca
Klang
Seremban
Port Dickson
Melaka
Johor Bahru
SINGAPORE
INDONESIA
KEPULAUAN ANAMBAS (INDONESIA)
KEPULAUAN NATUNA (INDONESIA)
BRUNEI
Miri
Bintulu
Sibu
Sarawak
Kuching
Borneo
INDONESIA
Lahad Datu
Tawau
Pulau Sipadan
Pulau Ligitan
Celebes Sea
Equator
200 km
200 mi

- Distribution

Locations of Dabai (*Canarium odontophyllum*) production.

Source: Jackson (2008). The Star.

Bambangan: Grown wild in Borneo Island includes Sabah, Sarawak, Brunei and East Kalimantan

High metabolizable energy ~235 kcal/100g

Proximate Composition of Fresh Pulp (%)		
	Canarium Odontophyllum (Dabai) (Voon & Kueh, 1999)	*Olea europea* (Olive) (McCance & Widdowson, 2000)
Moisture	41.3	16.35- 68.08
Fat	26.2	16.36 - 27.97
Protein	3.8	0.72- 2.16
Carbohydrate	22.1	8.02- 12.28
Ash	2.3	0.35- 1.24
Mineral content (g/100g)		
Element		
Potassium	0.81	0.53-3.39
Magnesium	0.10	0.01-0.06
Calcium	0.20	0.02-0.16
Sodium	-	0.01-0.22
Iron	0.0013	0.0003-0.009
Copper	0.0007	0.000003- 0.0005
Zink	0.00047	0.0001-0.003
Selenium	-	-
Fatty acid composition of pulp oil (%)		
	(Azrina et al., 2010)	
Fatty acids		
SFA	43.42 ± 0.05	22.00-11.70
MUFA	42.53 ± 0.06	78.00-41.65
PUFA	14.05 ± 0.09	60.10- 6.23
Oleic acids	14.05 ± 1.96	57.85- 72.70

Fatty acids of Dabai Kernel

Fatty acid composition of kernel oil (Azrina et al., 2010)		
	Dabai	Cocoa Butter
Saturated fatty acid	60.7	60.0
C16:0	46.3	8.4
C18:0	4.8	35.4
Monounsaturated fatty acid	35.6	35.5
C16:1	0.5	0.6
C18:1	35.1	15.3
Polyunsaturated fatty acid	3.7	3.1
C18:2	0.7	0

Total Phenolic Content of Dabai oil

Type of oil	Total phenolic content (mg GAE/100 g oil)
Dabai kernel oil	3.94
Palm oil	4.70
Dabai pulp oil (without skin)	14.0
Dabai pulp oil (with skin)	20.2
Olive oils	10.85 – 44.43

Carotenoid composition

Carotenoids (µg/g fresh weight)	Peel	Pulp	Seed
all-*trans*-lutein	1.62±0.03	0.36±0.01	0.67±0.01
9-*cis*-lutein	0.32±0.01	0.10±0.02	0.13±0.04
13-*cis*-lutein	0.62±0.01	0.16±0.009	0.11±0.01
di-*cis*-β-carotene	0.69±0.01	0.35±0.0005	0.37±0.01
15- *cis* - β-carotene	18.29±2.4	11.9±0.3	8.38±0.4
9-*cis*-β-carotene	39.61±0.28	5.8±0.69	3.20±0.3
all -*trans*-β-carotene	69.52±1.0	31.1±0.76	15.1±3.
13-*cis*-β-carotene	19.43±1.2	5.7±0.5	5.6±0.27
Total	149.48	55.47	33.56

Potential Health Benefits

Explore cardioprotective effect of Dabai parts using New Zealand White rabbits

Hypercholesterolemic
(0.5% Cholesterol)

(8 weeks)

Treatment

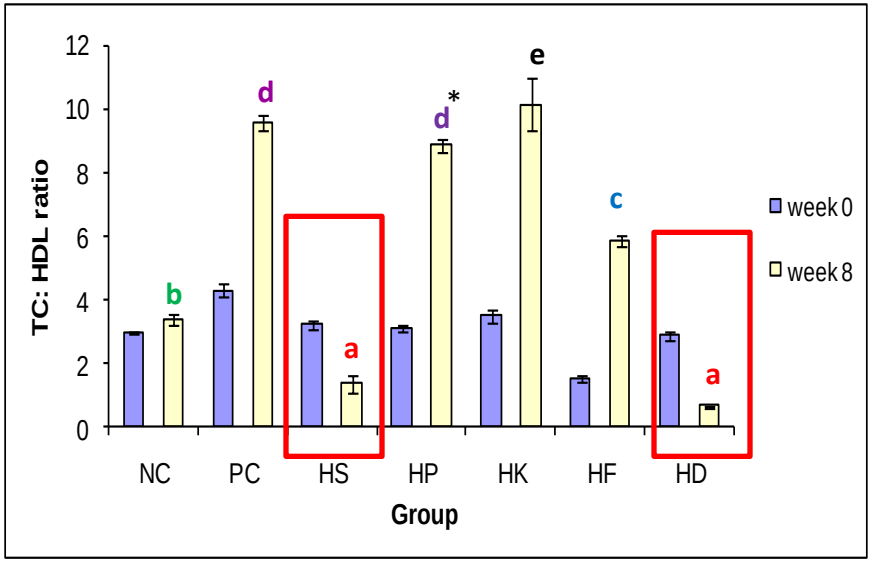
Normal cholesterol

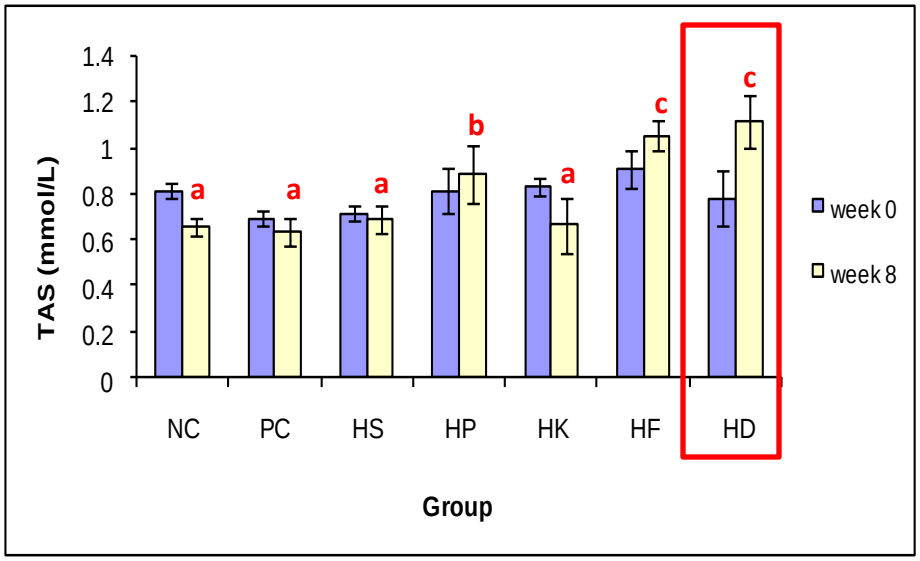
(4 weeks)

Prevention

HYPERCHOLESTEROLEMIC CONDITION

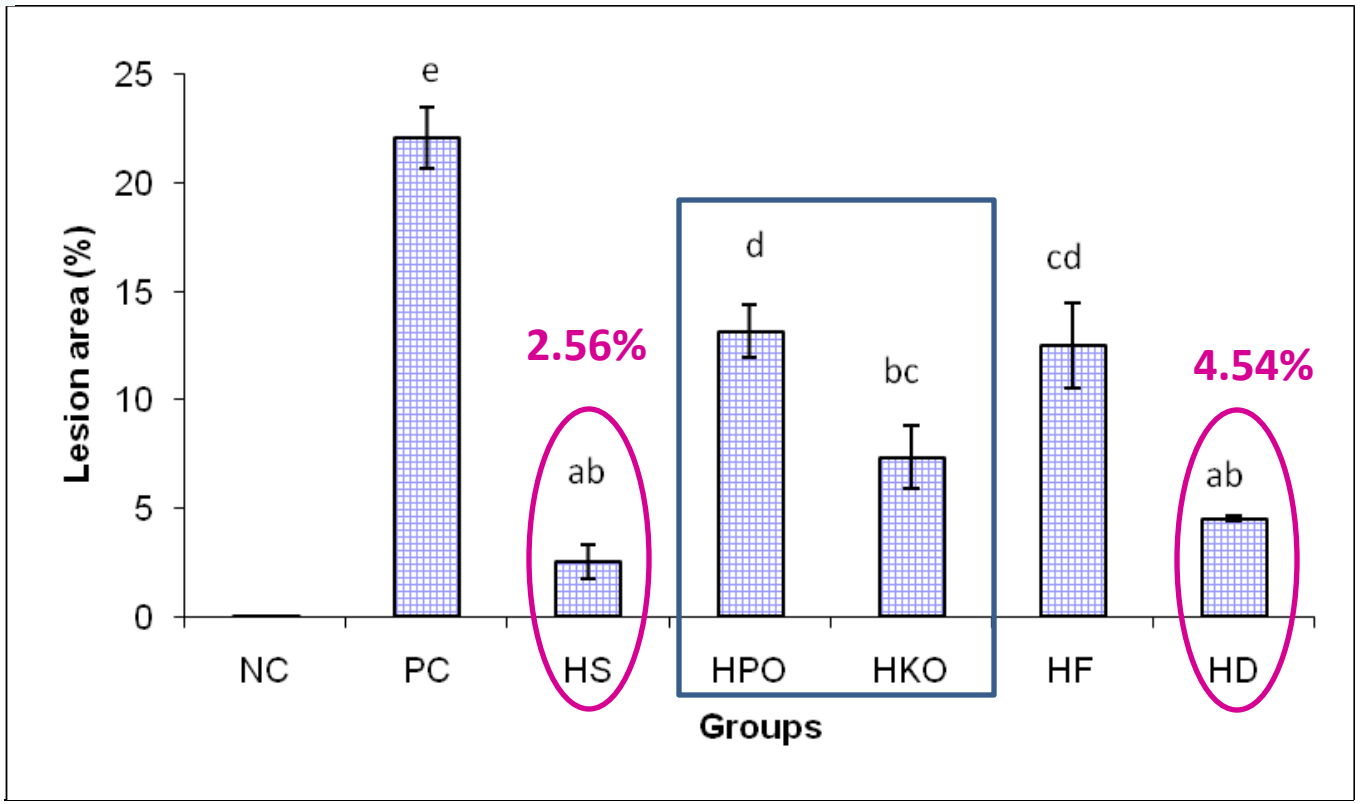
NC: negative control,
PC: positive control
HS: simvastatin
HP: pulp oil
HK: kernel oil
HF: fullfat pulp
HD: defatted pulp





Each value represents the mean ± SD.

Percentage of lesion area of intimal surface of aorta of animal groups



In **hypercholesterolemic** condition,

- Plasma lipids and antioxidant status were improved to an extend **BETTER than STATIN** following intake of **defatted pulp**
- **Fat** extracted from **pulp** of dabai has **more important effect** compared to kernel

Conclusions

- Dabai has high health-promoting components ….'super' fruit
- Dabai fractions offer prevention against CVD
- Attributed to bioactivity of multiple components in Dabai (vitamins, minerals, fiber, phytonutrients especially phenolic compounds)

Mangifera pajang (bambangan)

- Underutilised fruit
- Grown wild in Borneo Island includes Sarawak + Brunei
- 2-3 fold bigger than commercial mango
- Thick peel and
- Pleasant taste and aroma
- Its flesh has rich in antioxidants

Nutrient Composition of Bambangan

Proximate Composition and Gross Energy of Bambangan Pulp and Juice Powder		
Constituent	**Pulp**	**Juice Powder**
Moisture	86.84	10.01
Protein	1.13	3.78
Fat	1.98	1.75
Carbohydrate	21.02	76.09
Soluble Dietary Fiber	0.43	3.30
Insoluble Dietary Fiber	5.26	0.80
Total Dietary Fiber	4.84	0.l2
Ash	0.42	0.68
Gross Energy	428.68	335.23

Nutrient Composition of Bambangan

Antioxidant Properties of Bambangan Pulp and Juice Powder		
Antioxidant Parameter	**Pulp**	**Juice Powder**
Ascorbic Acid (mg/100 g)	**46.31**	**132.14**
β-Carotene (mg/100 g)	**42.21**	**35.59**
Total Phenolic Content (mg GAE/100 g)	26.09	19.30
Ferric Reducing Antioxidant Capacity (mM/100 g)	26.50	**39.58**
DPPH Radical Scavenging Activity (% in 1.0 mg/mL)	43.25	**52.61**

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY

Identification and Quantification of Phenolic Compounds in Bambangan (*Mangifera pajang* Kort.) Peels and Their Free Radical Scavenging Activity

Fouad Abdulrahman Hassan,[†,‡] Amin Ismail,*[,†,§] Azizah Abdulhamid,[†] and Azrina Azlan[†,§]

[†]Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra, Malaysia, UPM Serdang 43400, Selangor, Malaysia

[‡]Department of Food Science, Faculty of Agriculture, Ibb University, Yemen

Food Chemistry 126 (2011) 283–288

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Characterisation of fibre-rich powder and antioxidant capacity of *Mangifera pajang* K. fruit peels

Fouad Abdulrahman Hassan [a,b], Amin Ismail [a,c,*], Azizah Abdul Hamid [d], Azrina Azlan [a], Sadeq Hasan Al-sheraji [a,b]

[a]Department of Nutrition and Dietetics, Faculty of Medicine and Health Science, Universiti Putra Malaysia, UPM Serdang 43400, Selangor, Malaysia
[b]Department of Food Science, Faculty of Agriculture, Ibb University, Yemen

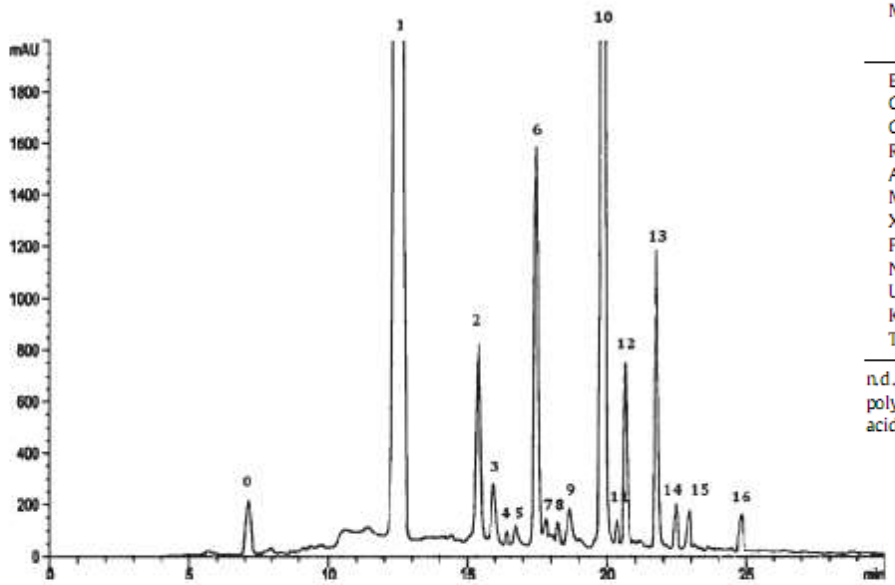


Figure 2. HPLC profile of phenolic compounds in *Mangifera pajang* peel, peak identification: 0, unknown; 1, gallic acid; 2, protocatechuic acid; 3, catechin; 4, chlorogenic acid; 5, methyl gallate; 6, mangiferin; 7, 4-hydroxybenzoic acid; 8, vanillic acid; 9, ethyl gallate; 10, *p*-coumaric acid; 11, ferulic acid; 12, rutin; 13, ellagic acid; 14, morin; 15, daidzein; 16, kaempferol.

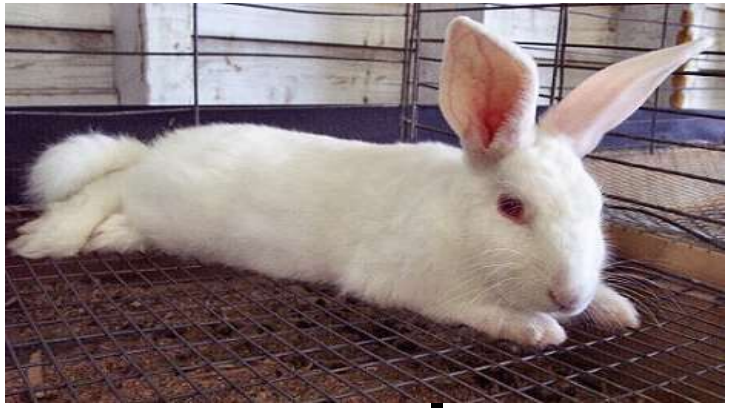
Table 3
Monosaccharide composition of SDF and IDF of the FRP.

Monosaccharide	Fibre-rich powder (% dry weight)	
	Soluble dietary fibre	Insoluble dietary fibre
Erythrose	n.d.	n.d.
Glucose	2.49 ± 0.23	1.15 ± 0.15
Galactose	0.80 ± 0.06	0.17 ± 0.01
Rhamnose	0.44 ± 0.02	0.20 ± 0.02
Arabinose	4.89 ± 0.28	3.05 ± 0.13
Mannose	12.49 ± 0.56	4.87 ± 0.22
Xylose	0.40 ± 0.14	0.09 ± 0.01
Fructose	0.15 ± 0.01	0.10 ± 0.01
Neutral sugars	21.66 ± 0.32	9.63 ± 0.53
Uronic acids	11.75 ± 0.23	7.60 ± 0.11
Klason lignin	n.d.	21.51 ± 0.47
Total NSP	33.41 ± 0.32	17.26 ± 0.52

n.d. Represents not detected. Mean values ± STD ($n = 3$). NSP is the non-starch polysaccharide representing the following equation: NSP = neutral sugars + uronic acid.

Potential Health Benefits

Explore health benefits of different dosage of Bambangan juice using New Zealand White rabbits



Hypercholesterolemic
(1.0 % Cholesterol)

(10 weeks)

Control: Rabbits fed with 1% cholesterol without any treatment for 70 days

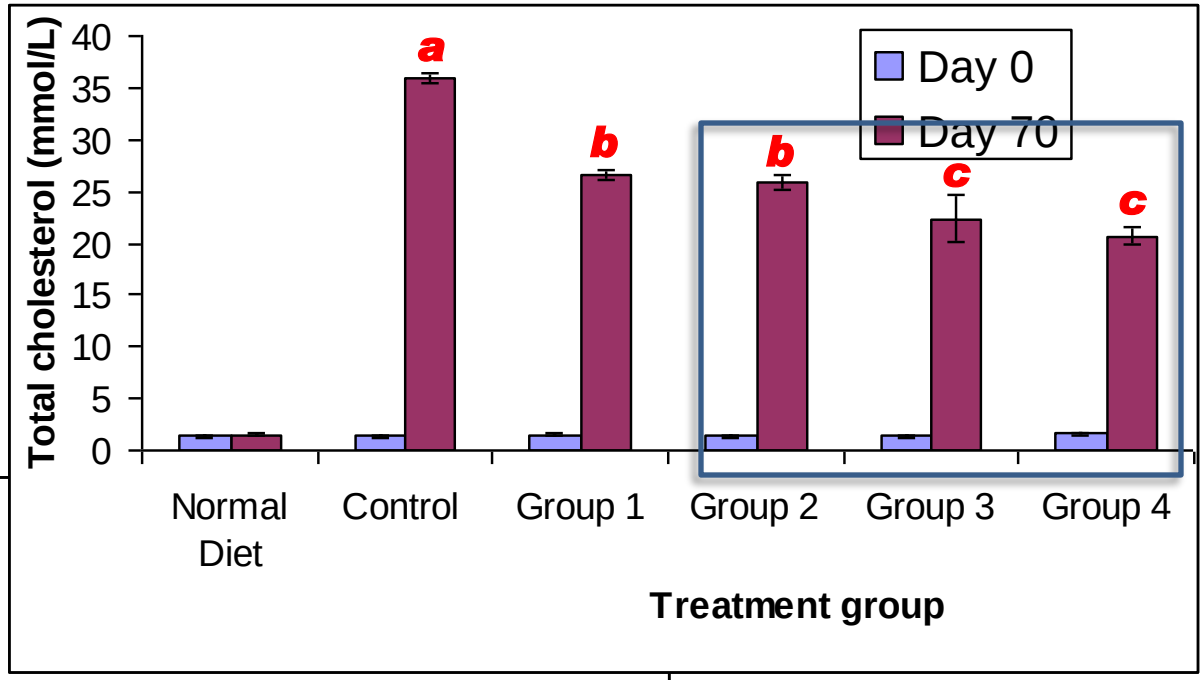
Group 1: 1% cholesterol + 5% Bambangan juice powder (BJP)/kg/day

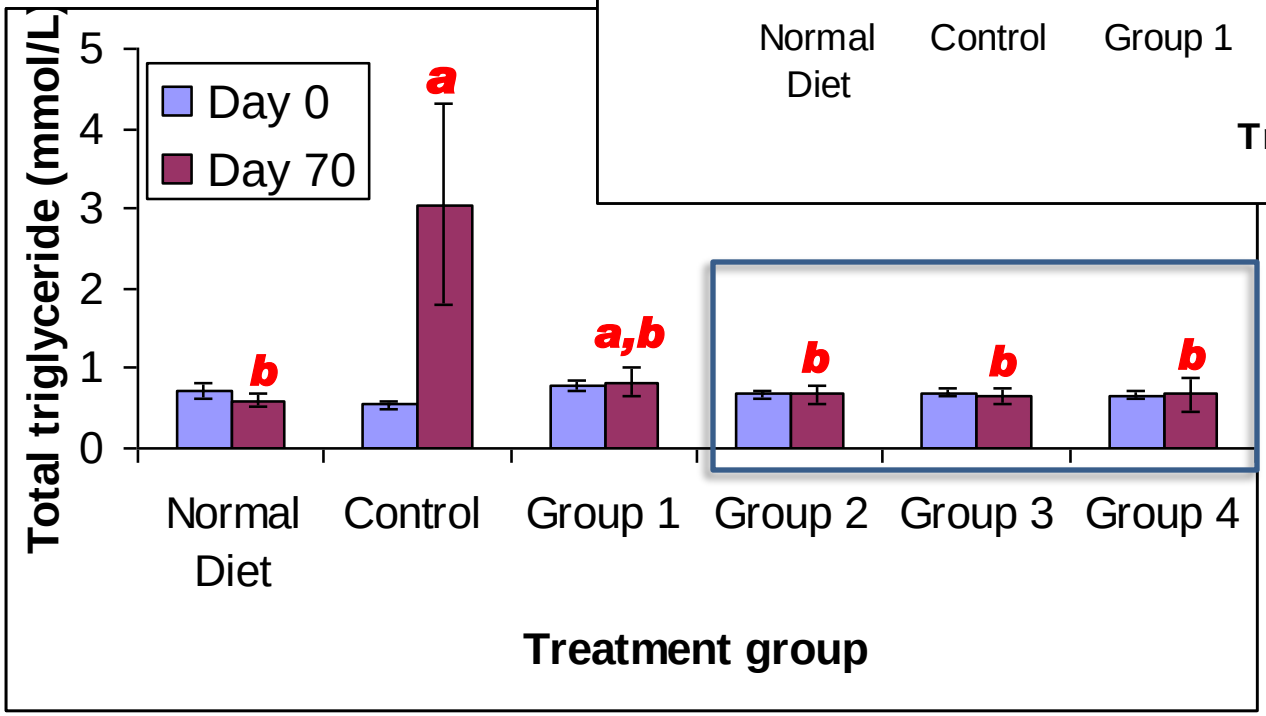
Group 2: 1% cholesterol + 15% BJP/kg/day

Group 3: 1% cholesterol + 25% BJP/kg/day

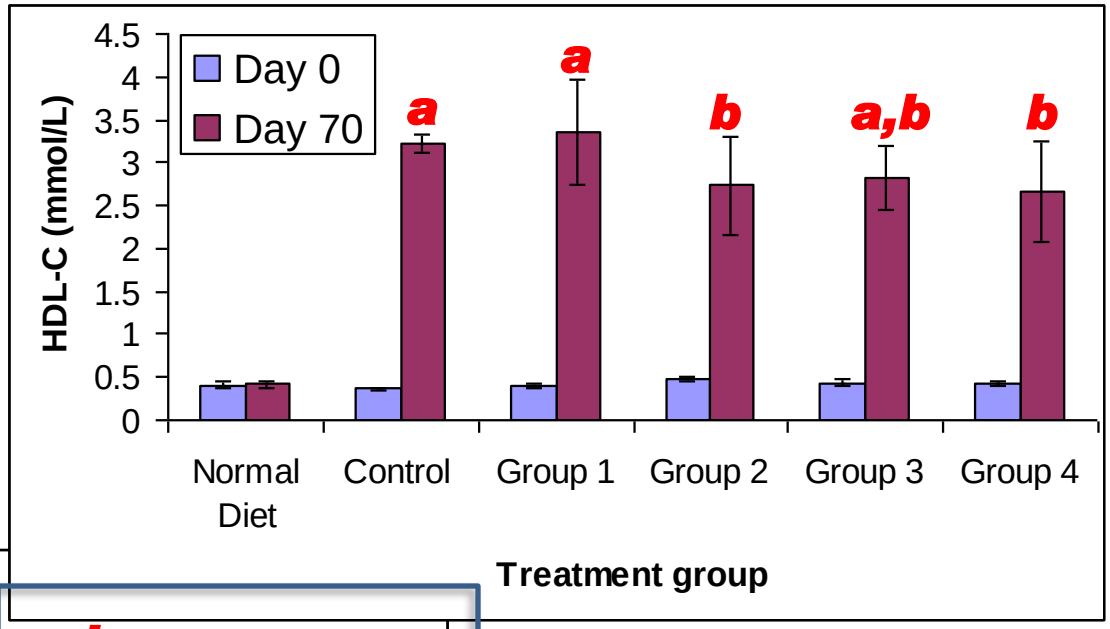
Group 4: 1% cholesterol + 35% BJP/kg/day

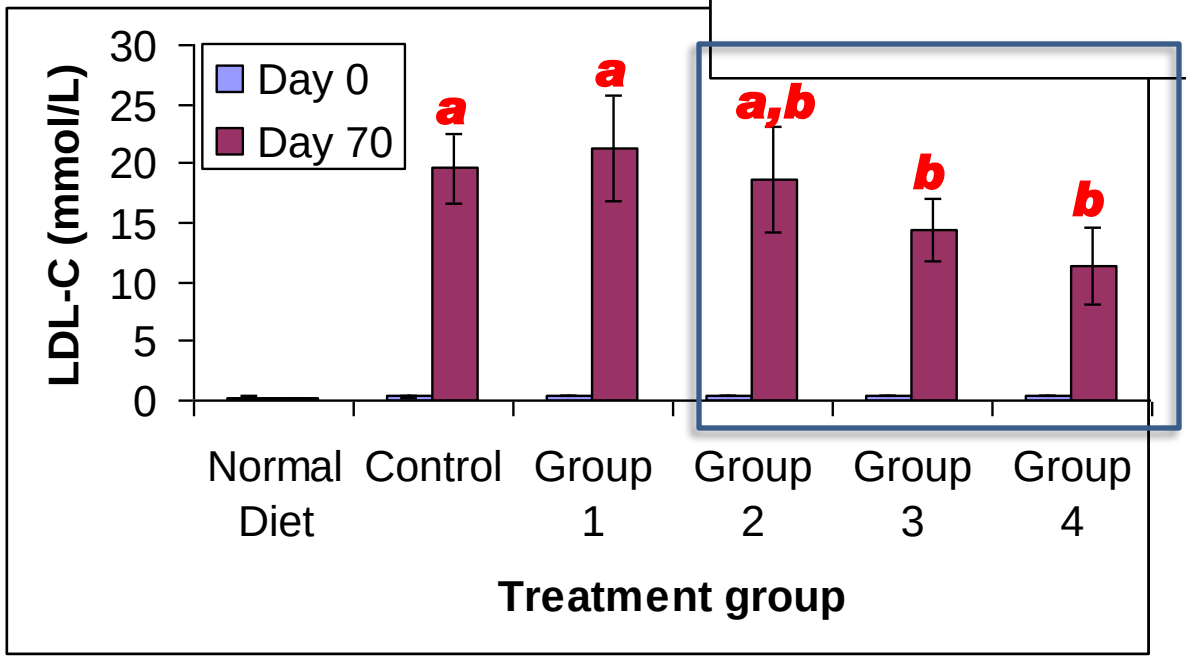
Treatment



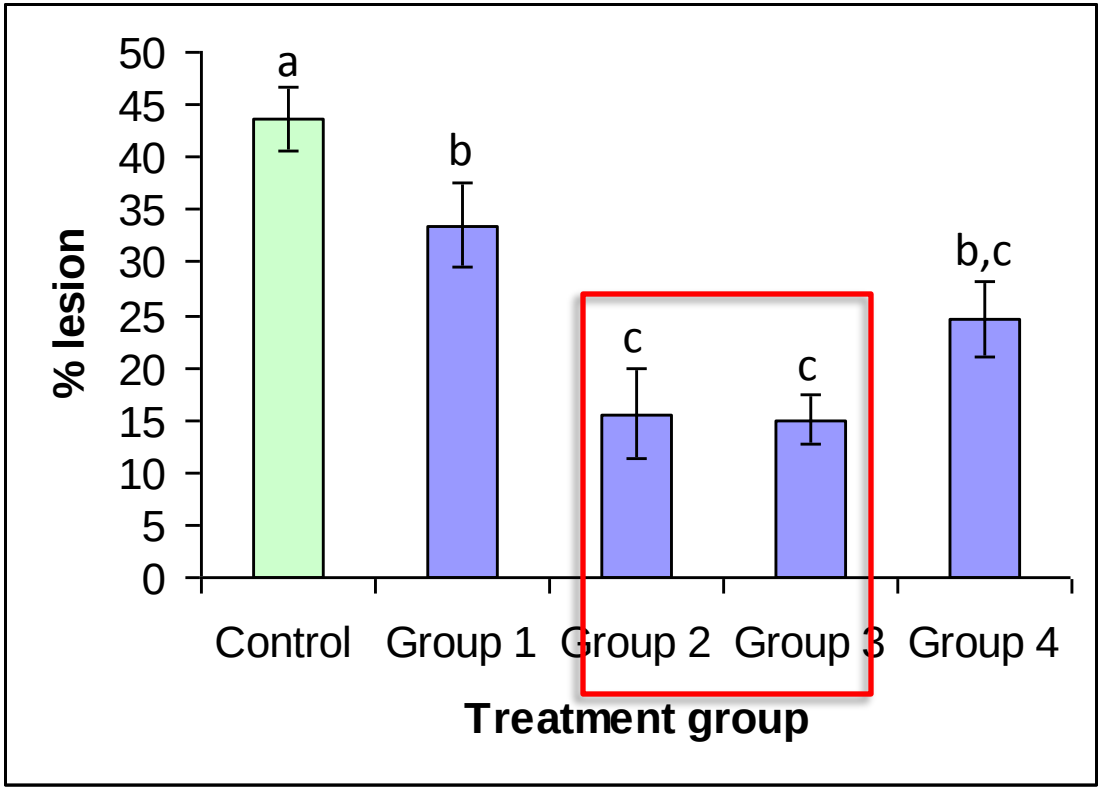


Blood Lipids

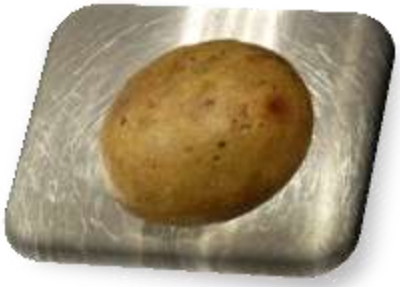

HDL-C (mmol/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Day 0
Day 70
a
a
b
a,b
b
Normal Diet
Control
Group 1
Group 2
Group 3
Group 4
Treatment group


LDL-C (mmol/L)
30
25
20
15
10
5
0
Day 0
Day 70
a
a
a,b
b
b
Normal Diet
Control
Group 1
Group 2
Group 3
Group 4
Treatment group

Atherosclerotic Lesion



Control: Rabbits fed with 1% cholesterol without any treatment for 70 days; Group 1: 1% cholesterol + 5% Bambangan juice power (BJP)/kg/day; Group 2: 1% cholesterol + 15% JP/kg/day; Group 3: 1% cholesterol + 25% JP/kg/day; Group 4: 1% cholesterol + 35% JP/kg/day



50 g MPJP
66 mg vit. C
18 mg β-carotene

To examine the effects of Bambangan juice powder (BJP) drink on:

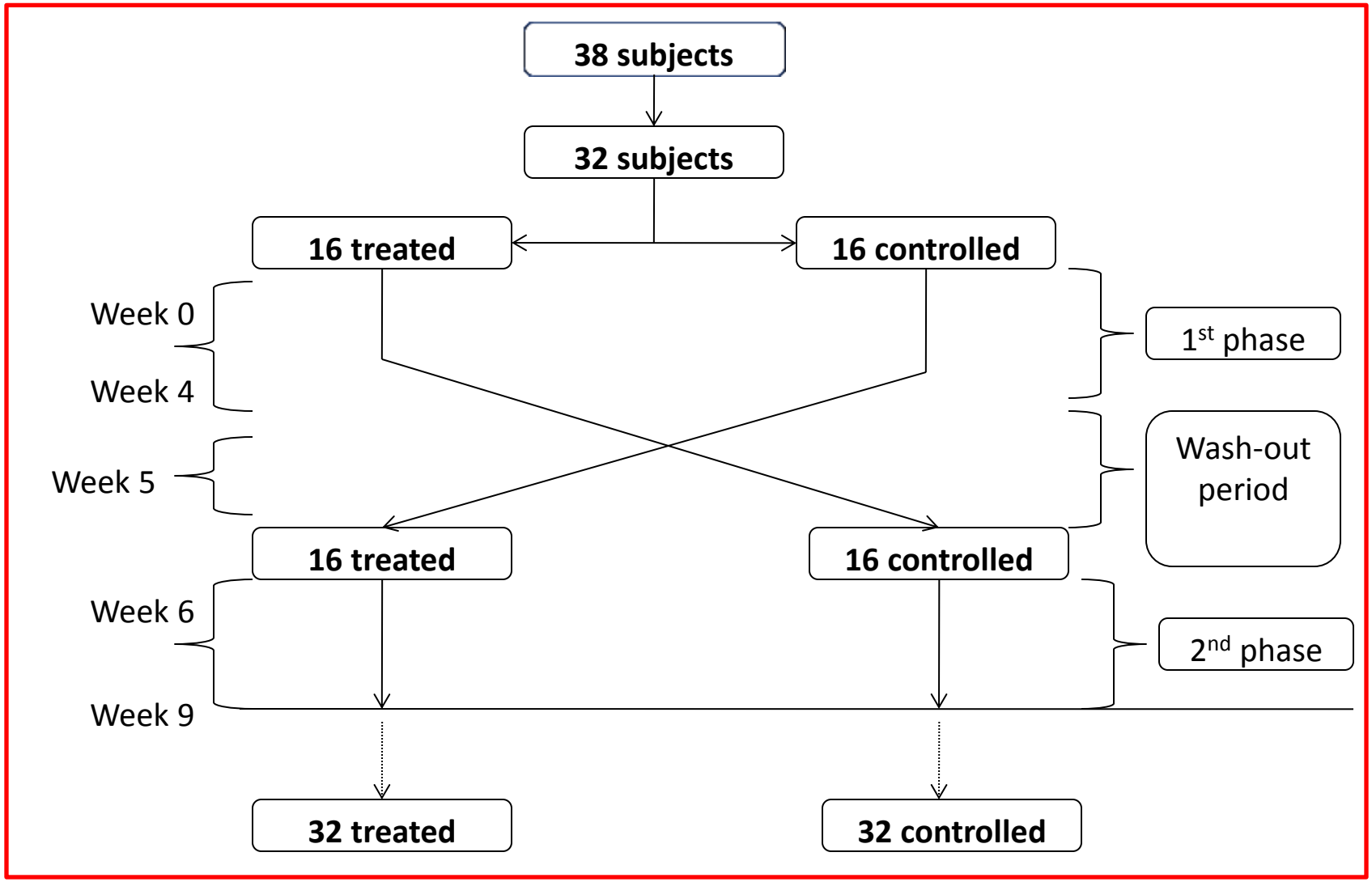
Lipid profiles, MDA and antioxidant levels of **healthy subjects** (normal cholesterol level-≤ 5.20 mmol/l) in a 30-day cross-over, single-blind, placebo-controlled study

250 ml BJP drink

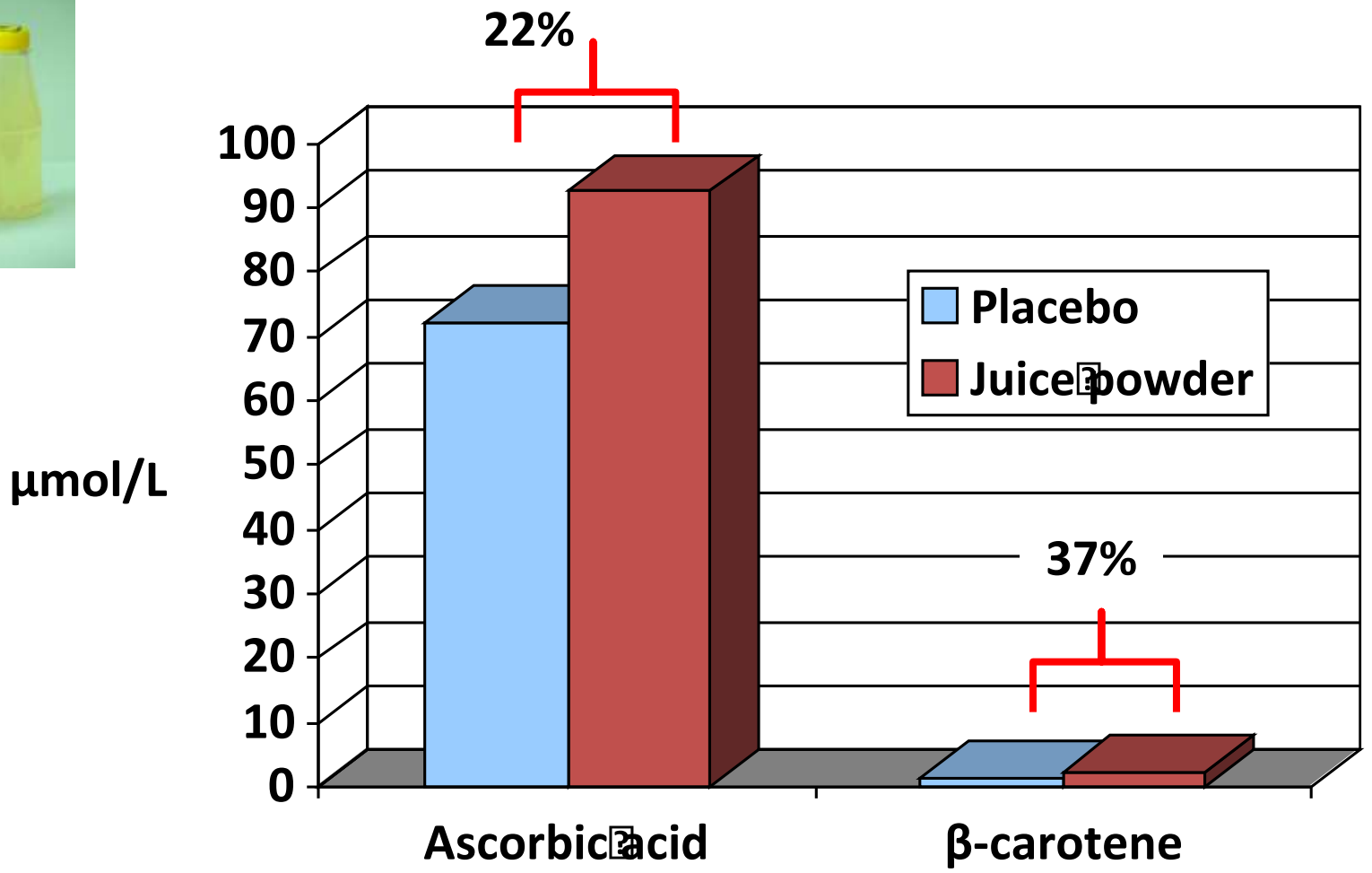
250 ml placebo drink

Source: Ibrahim (2010). PhD thesis

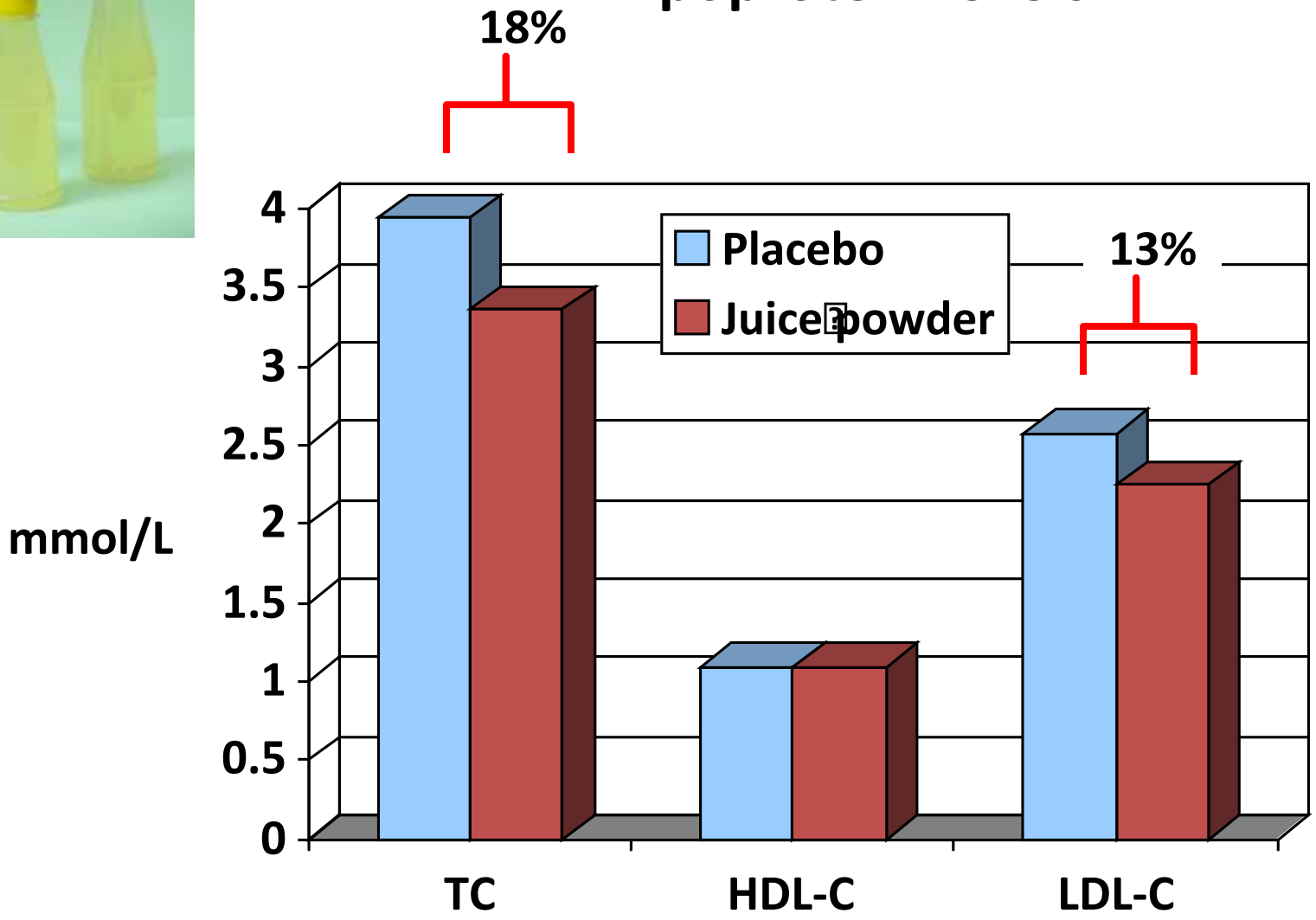
Experimental Design



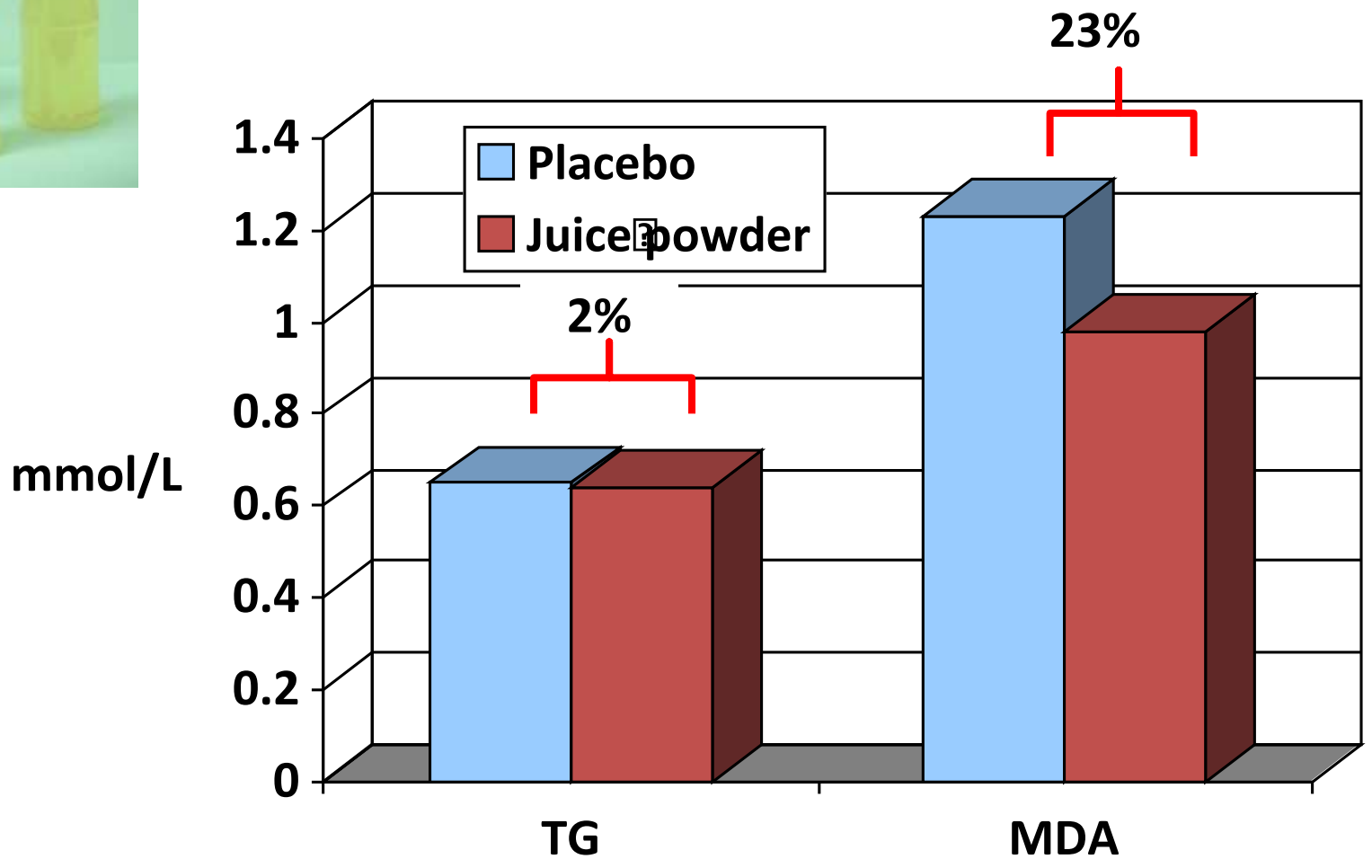
Ascorbic acid and β–carotene contents in plasma of the subjects supplemented with BJP



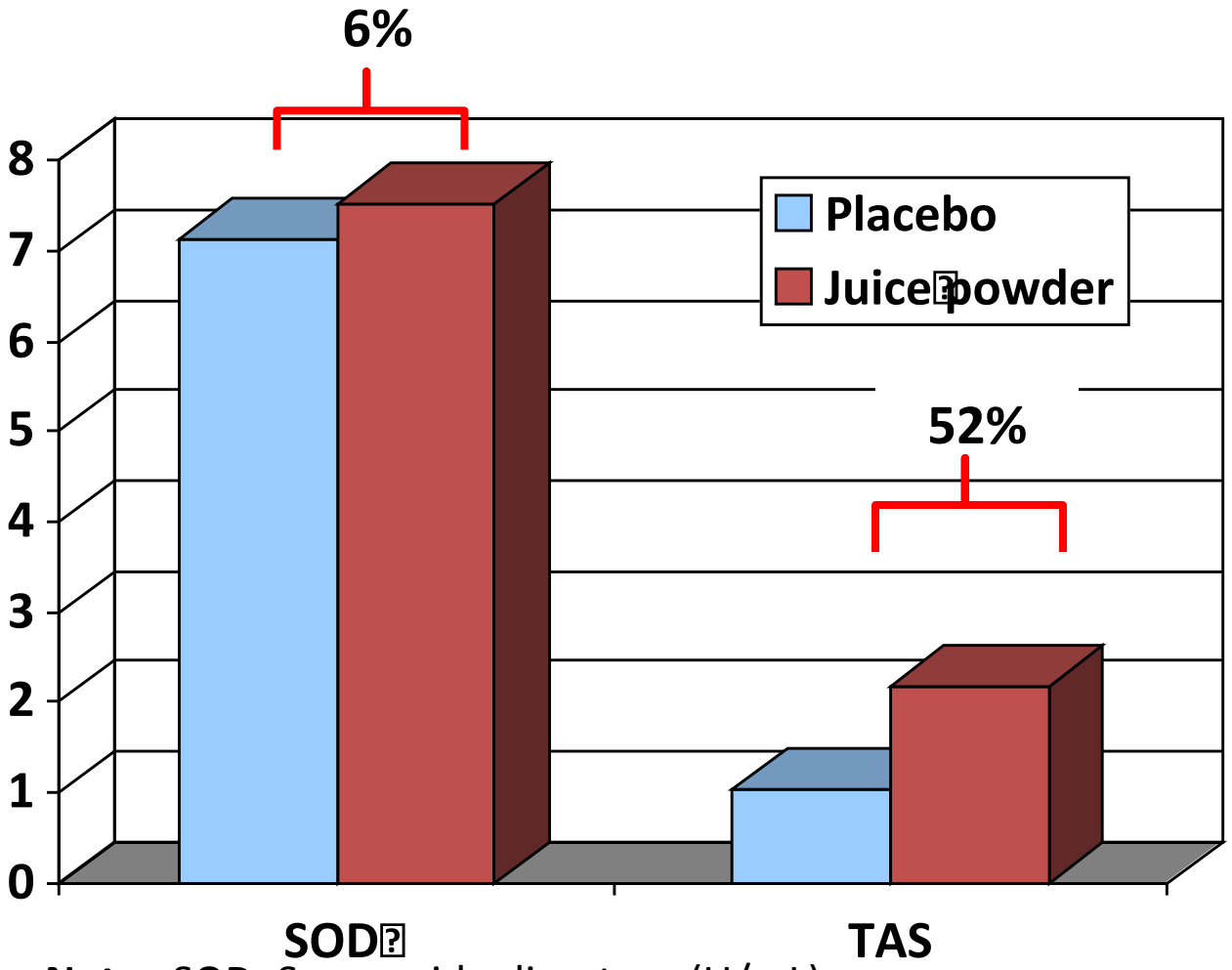
Effect of BJP on plasma total cholesterol and lipoprotein levels



Effect of BJP on TG and MDA levels



Effect of BJP on plasma antioxidant status



Note SOD: Superoxide dimutase (U/mL)
TAS: Total antioxidant status (mmol/L)

Conclusions

- Bambangan fruit **is rich in antioxidant compounds** (polyphenols, vitamin C and β-carotene).

- Its antioxidant properties shown significant effects on hypolipidemic and anti-atherosclerotic, especially BJP in animal and human studies.

- BJP supplemented group (normalcholesterolemic) had shown an increase in plasma TAS, β-carotene and ascorbic acid.

Concluding remarks

- RDI on health-promoting components will help the food industry to create new products for wellbeing based on the scientific data of the tropical fruits.
- The safety and efficacy of such products on human subjects through randomized clinical trials are the ultimate before making health claims.
- Our underutilised ‘super’ fruits (UF) have a potential to be placed along with commercial & export fruits for dietary diversity, food security, poverty alleviation for rural communities.
- More research should be focused on UF
- We are really need a balanced diet includes a variety of functional food component-rich food is important for the promotion of our health.

Acknowledgements

- **MOSTI, MOHE, MOA, UPM; ARC, Sarawak; MARDI, MCB**
- **My collaborators**
  - **AP Dr. Azrina Azlan, AP Dr. Muhajir Hamid, AP Dr. Chong Pei Pei, AP Dr. Azizah Abd. Hamid, UPM**
  - **Mr Lau Cheng Yuon, ARC; Dr. Salma, MARDI**
- **My international collaborators**
  - **Prof. F. Shahidi, Memorial Univ. of Newfoundland, Canada**
  - **Prof. Chin Kun Wang, Chung Shan Medical Univ., Taiwan**
  - **AP Dr. Sun Jian, Guangxi Agricultural Research Academy, China**
  - **AP Dr. Bao Yang, South China Botanical Garden, Chinese Academy of Sciences, China**
  - **Dr. J. Arcot, UNSW, Australia**
  - **Dr. Yoshito Ando, Kyushu Institute of Technology, Japan**
- **My students**


Guava
Star Fruit
Mango
Cherimoya "Custard Apple"
Pepino
Thank you for your attention
Kiwano "Horned Melon"
Passion Fruit
Papaya
Pineapple
TROPICAL FRUIT