

REPUBLIQUE DU CAMEROUN

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FACULTE DE MEDECINE ET DES

SCIENCES BIOMEDICALES



REPUBLIC OF CAMEROON

Peace-Work-Fatherland

THE UNIVERSITY OF YAOUNDE I

FACULTY OF MEDICINE AND

BIOMEDICAL SCIENCES

**The Effect of add-on *Spirulina platensis* Supplementation on
the Metabolic Profile of Cameroonian Patients with Type 2
Diabetes.**

A thesis presented in partial fulfilment of the requirements for a Medicinae Doctor (MD)

degree by

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PLAN

- Introduction
- Objectives
- Methods
- Results and Discussion
- Conclusions
- Recommendations
- Summary in the French language

DIABETES MELLITUS (DM)

- 5th leading cause of death world wide.
- A 21st Century global health emergency.
- Co-morbidities increase cost of management.
- Synthesized drugs have non-negligeable side effects.
- Need for less costly, more natural anti-diabetic treatment sources.

Spirulina platensis

- Blue-green algae, declared 'best food for tomorrow' by the UN's world food congress.
- Nature's richest source of organic nutrition.
- Rich in proteins, phytonutrients and anti-oxidants but poor in cholesterol content.
- Has anti-hypertensive, hypoglycemic and hypolipidaemic properties among others.



Fig1: Spirulina

RATIONALE

An 8-week add-on Spirulina platensis food supplementation could better the metabolic profile of Cameroonian patients with type 2 diabetes by probably improving their insulin sensitivity.

GENERAL OBJECTIVE

- To investigate the effect of an 8-week add-on Spirulina platensis supplementation on the metabolic profile of patients with type 2 diabetes.

SPECIFIC OBJECTIVES

1. Assess insulin sensitivity, insulin secretion, HbA1c, blood glucose and the lipid profile in patients with type 2 diabetes, at base line.
2. Reassess these parameters, after 8 weeks of add-on spirulina supplementation.
3. investigate the effect of add-on spirulina supplementation on the parameters.

- Study design: Non-randomized single-arm trial
- Study duration: 08 months
- Study site: National Obesity Centre, Endocrine unit (YCH), Biotechnology Centre Nkolbissong.
- Sample size: 10 subjects minimum [1]
- Sampling method: Consecutive
- Study population: type 2 diabetic patients with HbA1c range between 6.5% - 8%.

ELIGIBILITY CRITERIA

INCLUSION

- Known type 2 diabetic patients for at least a year
- Patients not more than 75 years of age
- HbA1c value between 6.5 – 8%

EXCLUSION

- Refusal to participate
- Treatment modification within the last 3 months prior to recruitment.
- Pregnancy, infection, surgery, haemoglobinopathies.
- Severely altered hepatic and renal function tests.

METHODS

PROCEDURE

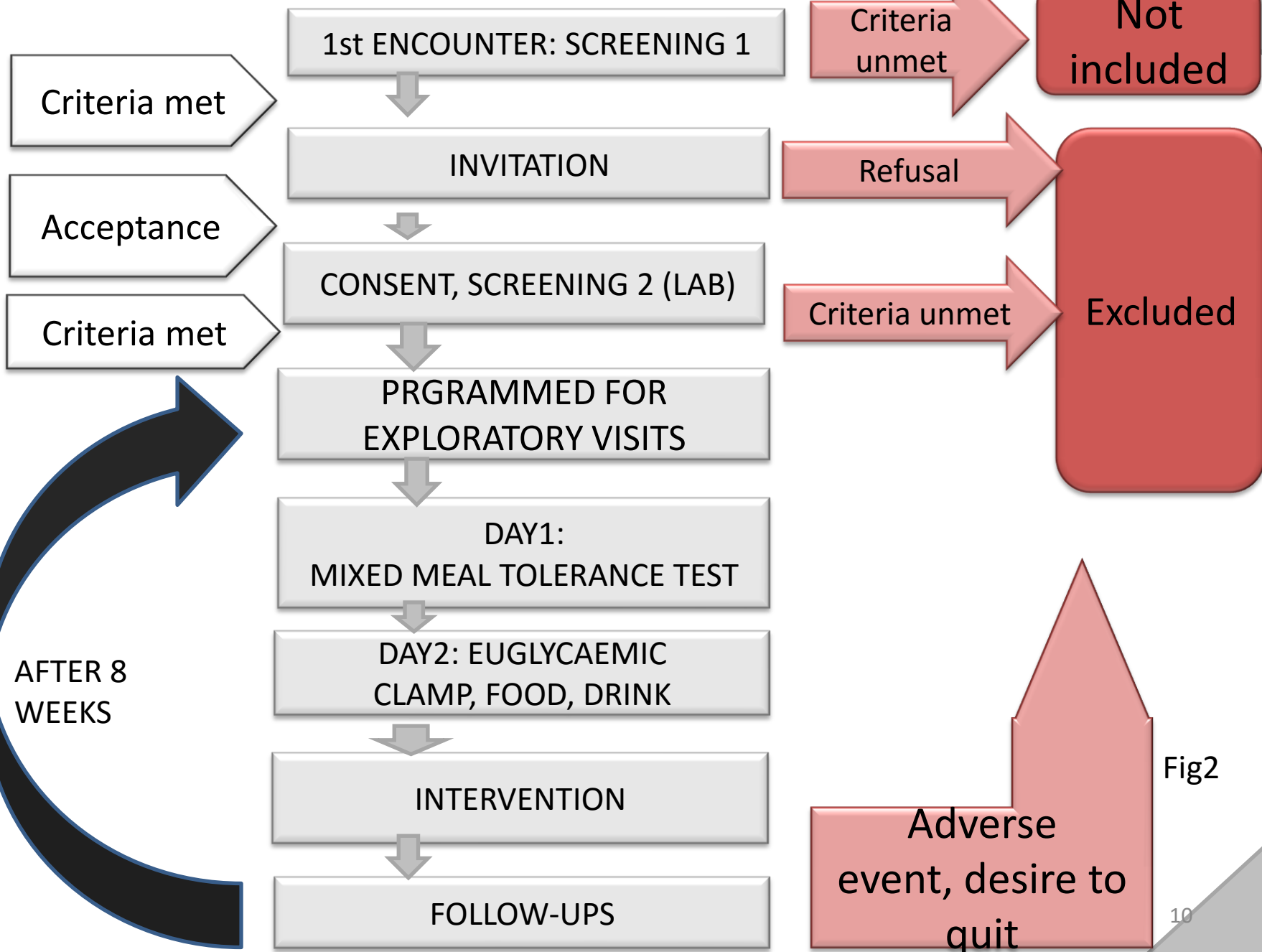


Fig2

- Clinical exam; anthropometric parameters
- The mixed meal tolerance test

1st

exploratory visit

verify

Pre- exam conditions
Record of last food and actual clothing

MMTT

Clinical evaluation :
Vital and anthropometric parameters recordings, IV line.

Lipid profile; C-peptide and glucose(0,30,60,90,120 mins)

samplings

To the laboratory

Fig3: MMTT¹¹

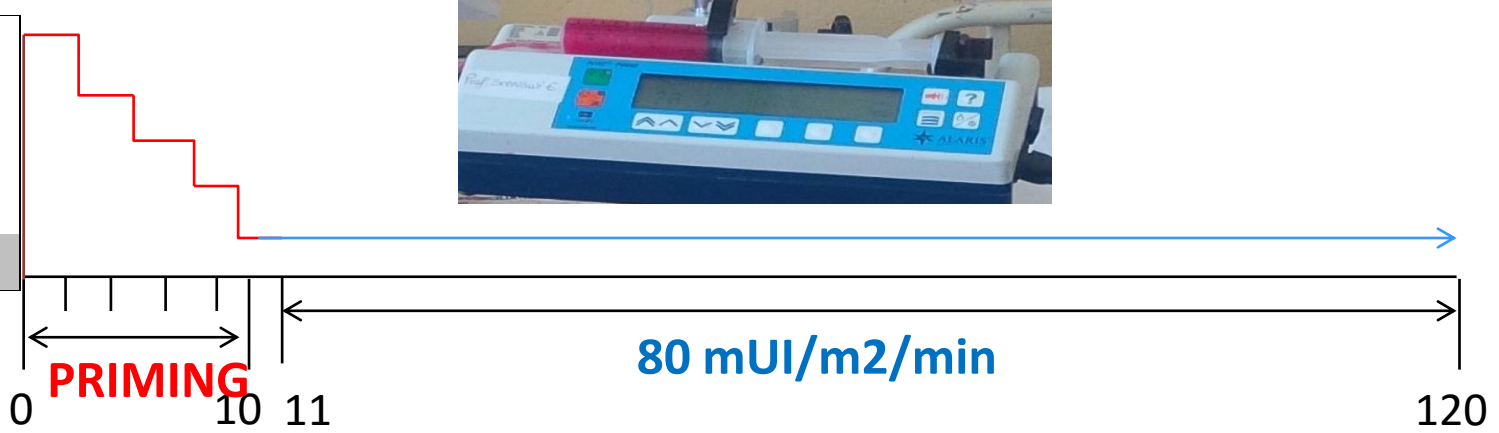
METHODS



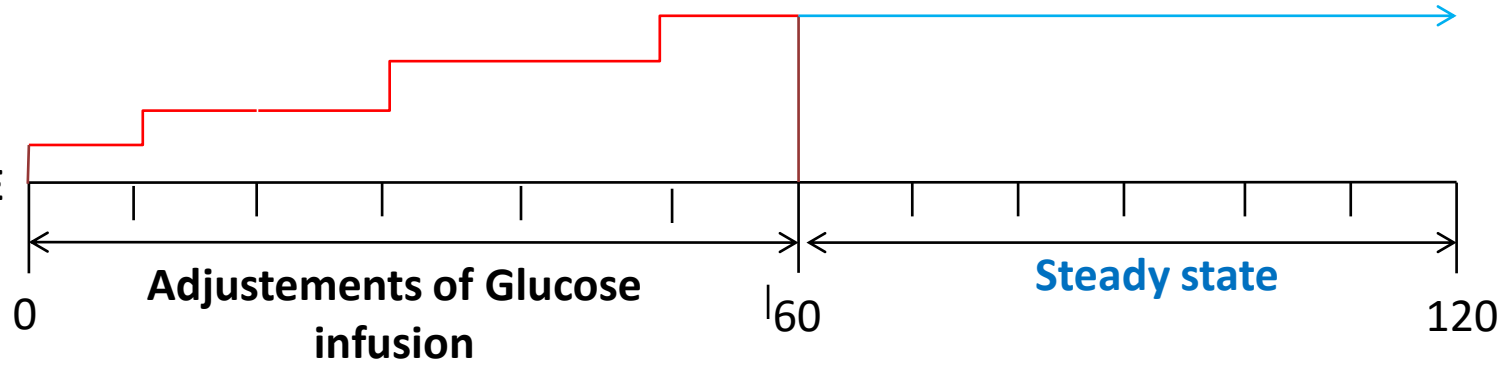
Time min	Insuline infusion rate mU/m2/min	ml/h
0	250,8	66,9
2	108,8	29,0
4	98,8	26,3
6	94	25,1
8	86	22,9
10	80	21,3
10 -		
120	80	21,3



INSULIN



GLUCOSE



GLYCEMIA

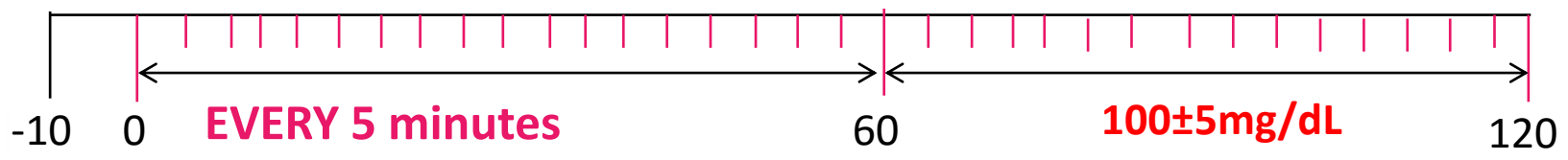




Fig : Candidate clamping a study participant

INTERVENTION

- Production unit: CREDESA/SSP/PAHOU Cotonou-Benin as Spiruline DOU BOGAN[®] powder.
- Quantity: daily 10g sachets.
- It was Supplied to patients every other week.
- To be taken before supper, as a warm drink.
- A Spirulina-intake and clinical-monitoring sheet was handed to patients.

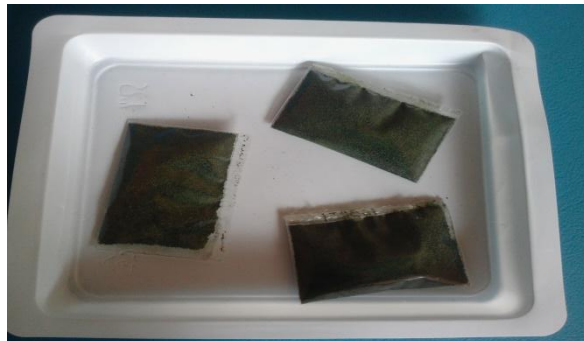
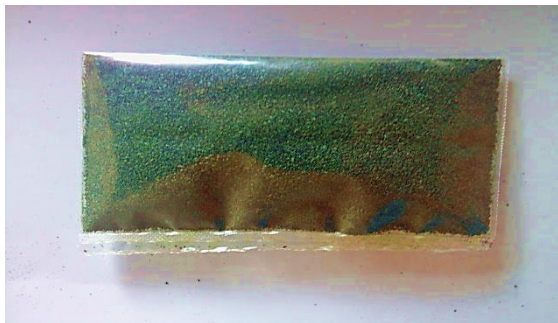


Fig 5: 10g spirulina sachet

FOLLOW – UP AND CLINICAL MONITORING

EVERY OTHER WEEK WE EVALUATED:

- Patients' general well-being
- Number of missed days of spirulina intake
- Adverse events
- Vital parameters
- Feeding habits and physical activity

ON WEEKS 0, 4, 8, 10 AND 14

- Evaluation of renal and hepatic function tests
- Follow-up data was evaluated by the data safety and monitoring board.

BIOCHEMICAL ANALYSIS

Lipid profile, BG, ALAT, atinine

Analysis

4000 rpm
10 minutes.

centrifugation



C-peptide



C-peptide
plate shaker



UV-VIS
spectrophotometer

5 ml whole
blood



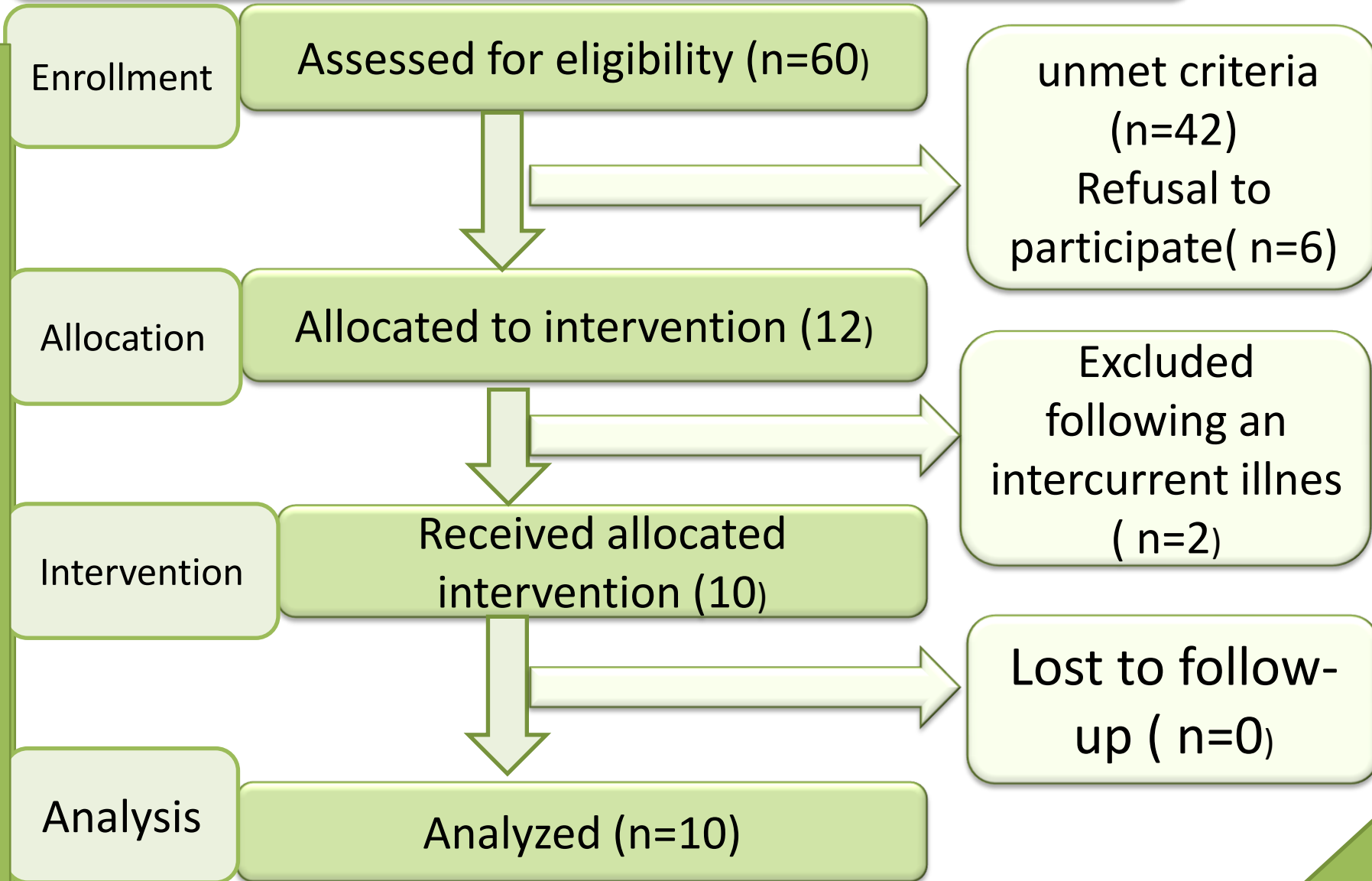
METHODS

ETHICAL ISSUES AND STATISTICAL METHODS

- Authorization: Yaoundé Central Hospital.
- Ethical clearance request: NEC, FMBS
- Data confidentiality was ensured.
- Collected data was entered into, and analyzed using SPSS 20.0 software.
- Comparing medians: Wilcoxon Ranked sum test.
- Correlations: Spearman correlation test.
- Significant $p \leq 0.05$

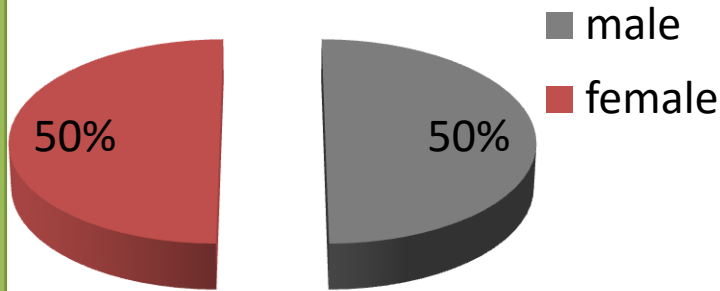
PARTICIPANTS FLOW

RESULTS

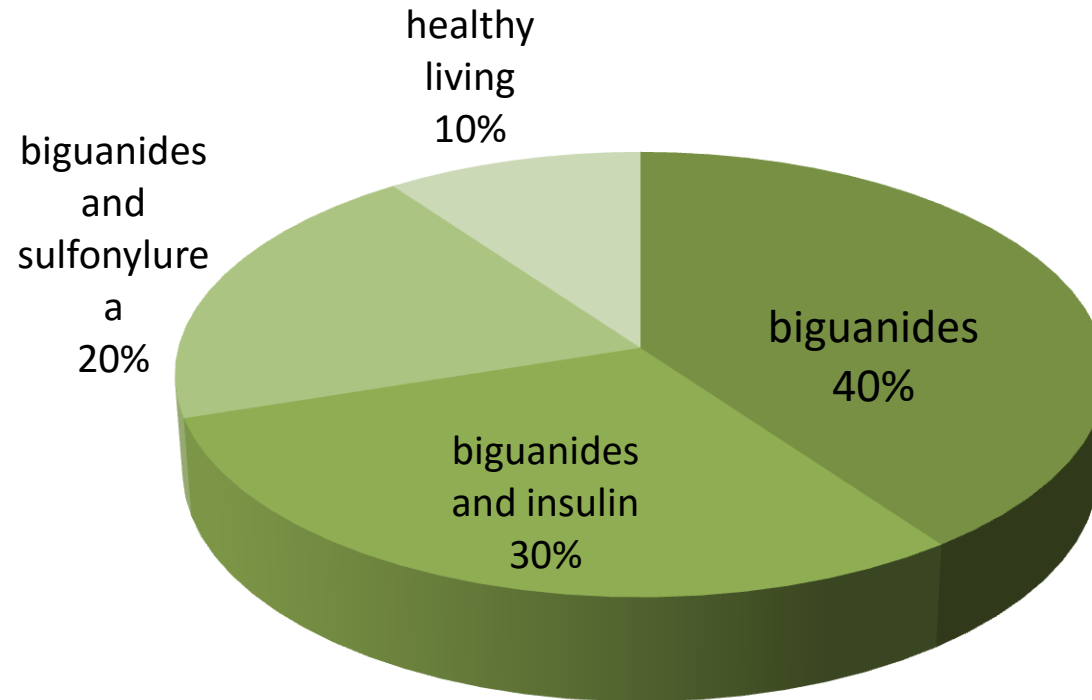


CHARACTERISTICS OF STUDY POPULATION

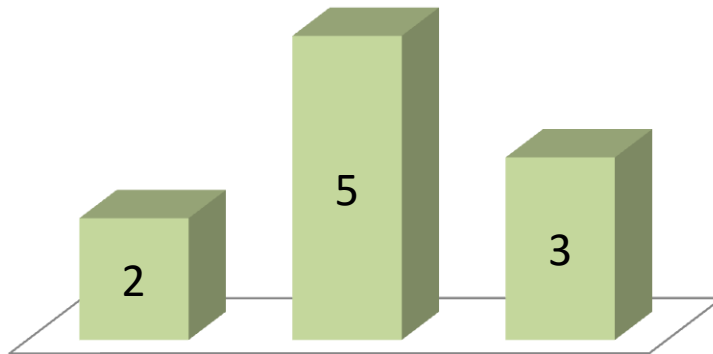
Gender



Anti-diabetic treatment



Age distribution



40-49 years 50-59 years ≥ 60 years

Anthropometric data before and after intervention

Characteristics	Baseline parameters	Post-intervention parameters	P*
SBP (mmHg)	130 [127-139]	128 [120-130]	0.02
DBP (mmHg)	81.0 [72- 89]	76.0 [72-81.0]	0.01
Weight (Kg)	68.1 [52.5-77.1]	67.8 [53.6-78.1]	0.51
BMI (Kg/m ²)	24.2 [21.0-28.6]	24.2 [21.5-28.9]	0.61
% body fat	20.8 [18.7-31.5]	23.2 [18.9-33.0]	0.03
Fat mass	14.2 [11.5-23.5]	14.8 [11.9-25]	0.03
Fat-Free mass	53.0 [42.9-56.3]	52.9 [41.9-54.6]	0.04

Suestenal et al. (2001)

Azabji-K et al. (2011)

Sixabela et al. (2011)

BIOLOGICAL PARAMETERS BEFORE AND AFTER INTERVENTION

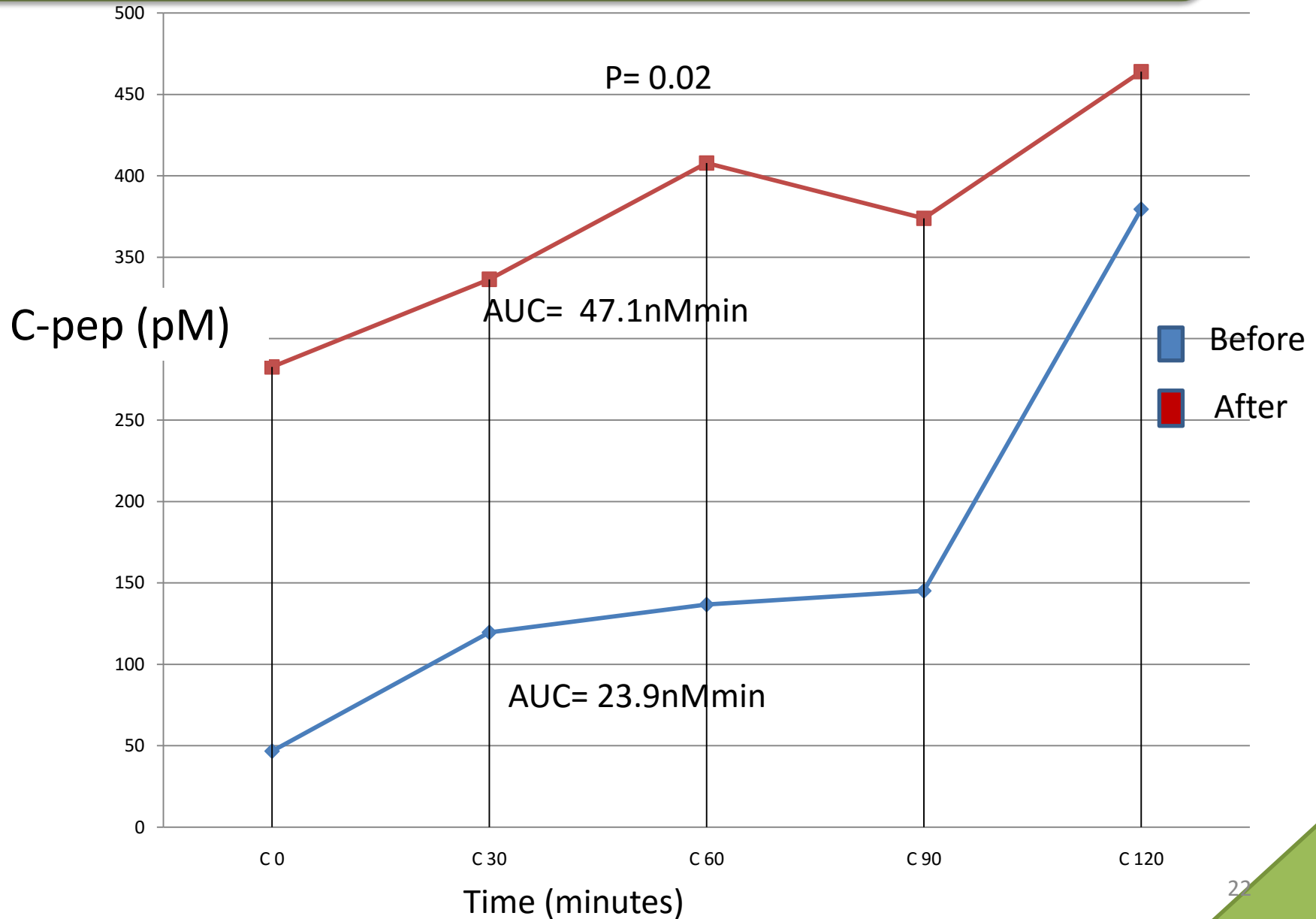
RESULTS

Characteristics	Baseline parameters	Post- intervention	P*
Triglycerides(g/L)	1.16 [0.98-1.18]	0.92 [0.79-0.96]	0.01
Total cholesterol(g/L)	1.41 [1.34-1.59]	1.14 [0.97-1.30]	0.01
HDL-C (g/L)	0.47 [0.42-0.48]	0.42 [0.37-0.44]	0.12
LDL-C(g/L)	0.81 [0.73-0.88]	0.53 [0.41-0.74]	0.01
Atherogenic index	3.34 [2.96-3.58]	2.77 [2.52-3.06]	0.03
HbA1c (%)	6.95 [6.58-7.45]	6.80 [5.95-6.90]	0.02
FPG(g/L)	1.22 [0.97-1.61]	1.09 [1.01-1.24]	0.28

Lee et al. (2008)

Ngo-Matip et al. (2014)

INSULIN SECRETION BEFORE AND AFTER INTERVENTION

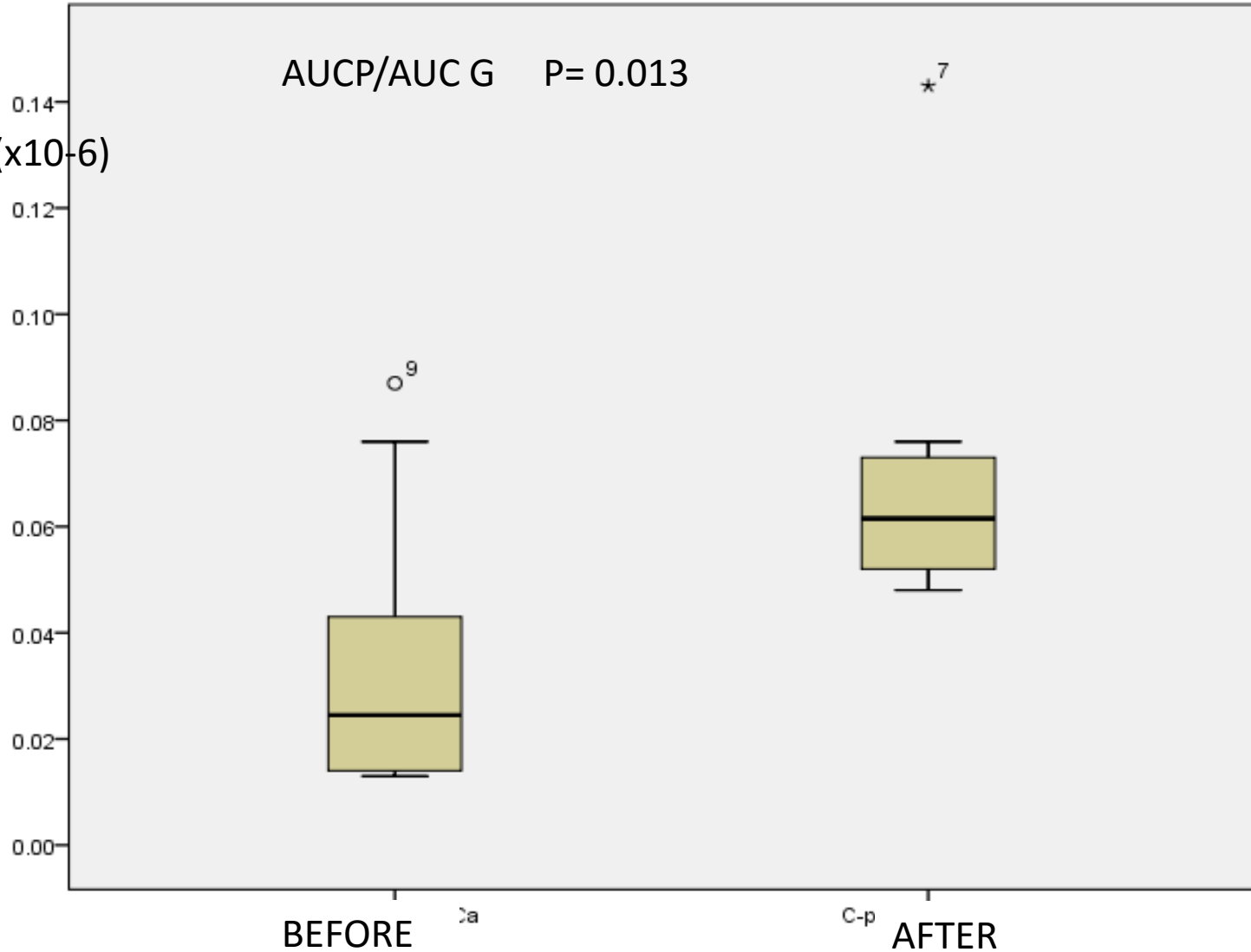


RESULTS

OVERALL BETA-CELL ACTIVITY BEFORE AND AFTER INTERVENTION

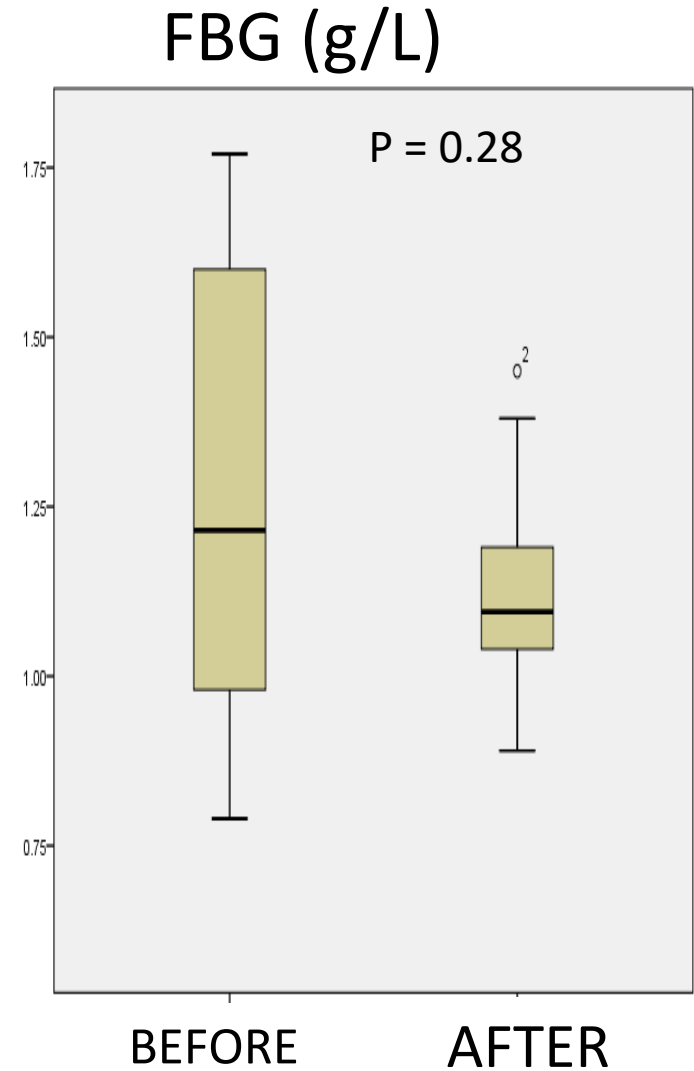
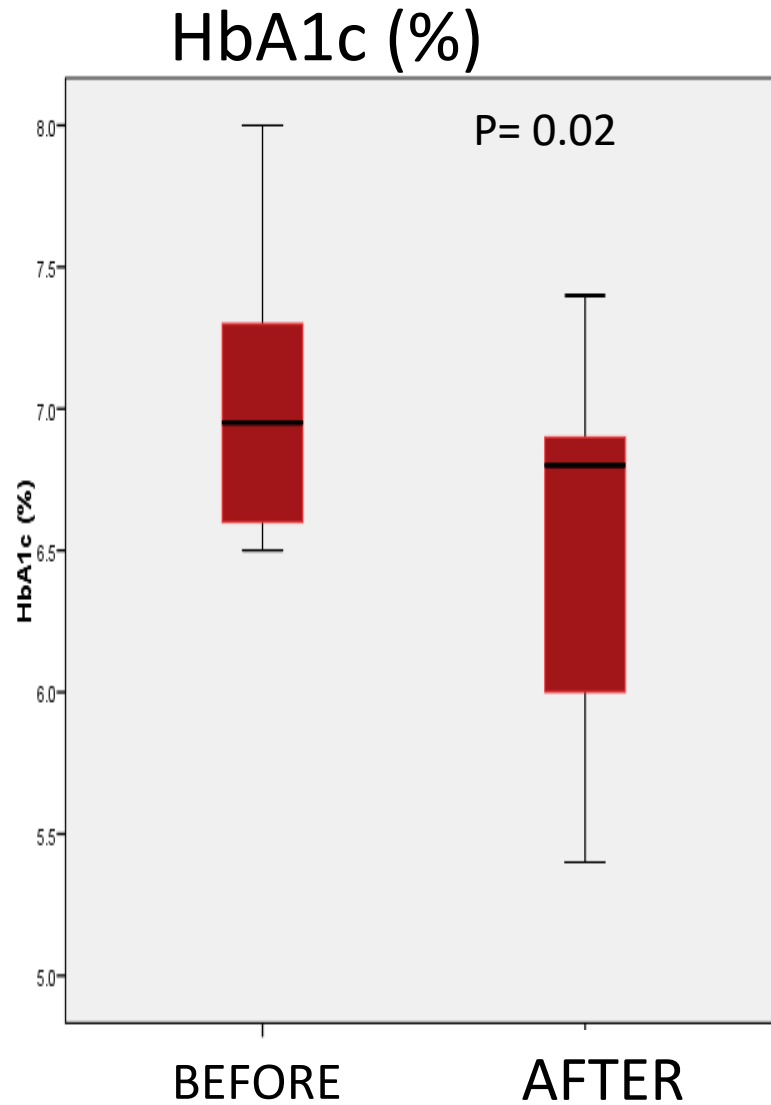
RESULTS

AUCP/AUCG (x10⁻⁶)



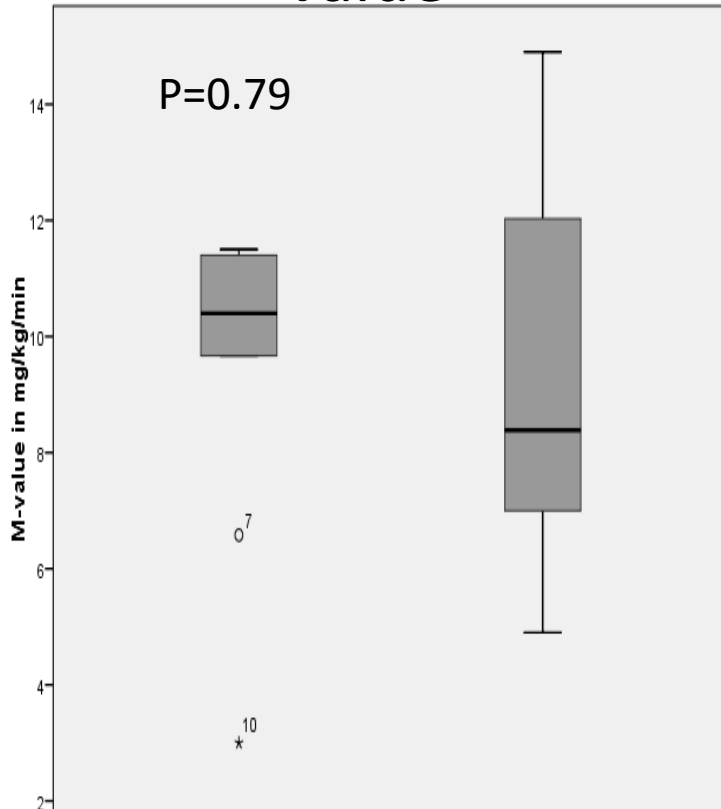
OVERALL GLUCOSE RESPONSE BEFORE AND AFTER INTERVENTION

RESULTS



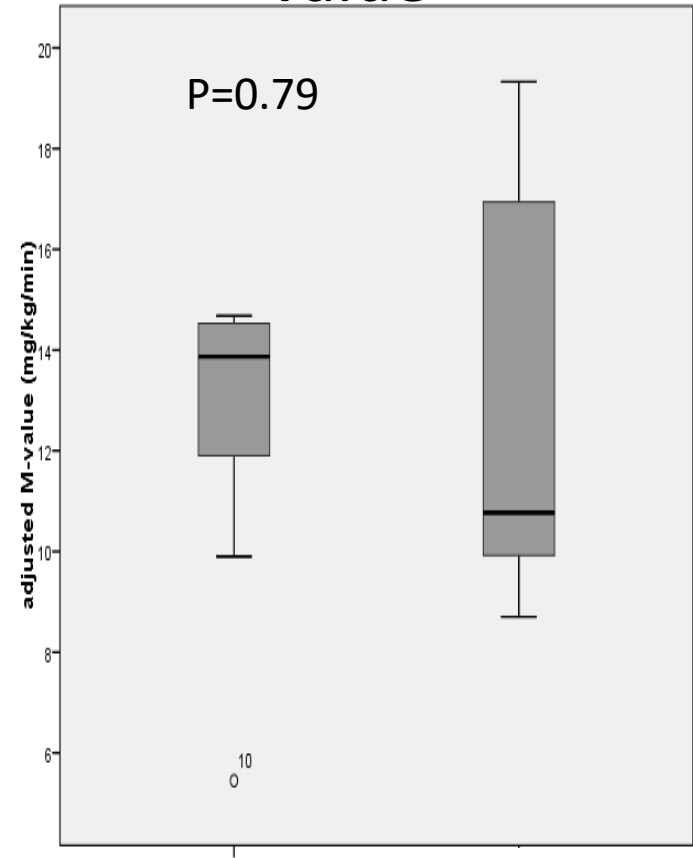
INSULIN SENSITIVITY (M-VALUE BEFORE AND AFTER INTERVENTION)

Unadjusted M-value



Before After

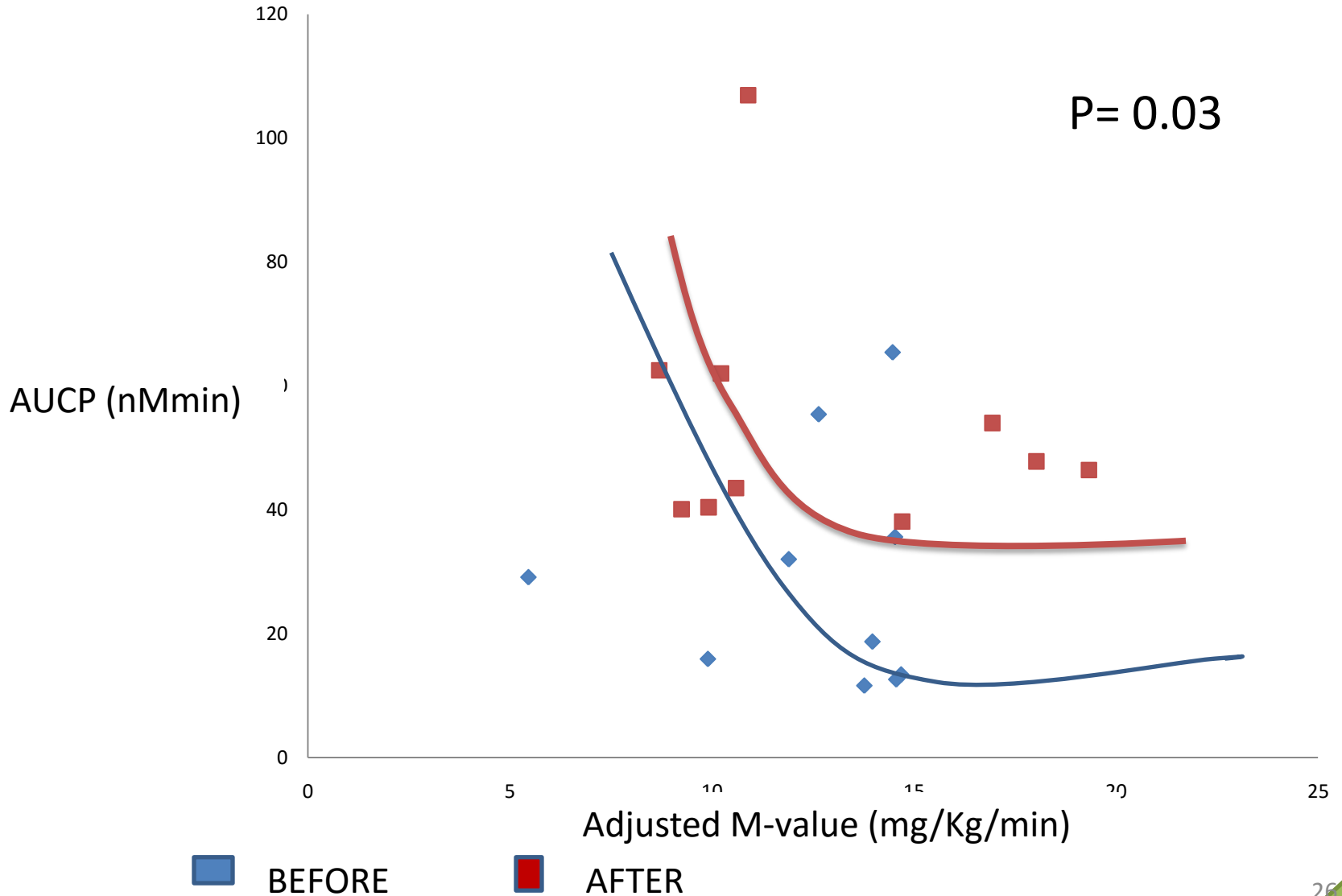
Adjusted M-value



Before After

INSULIN DISPOSITION INDEX BEFORE AND AFTER INTERVENTION

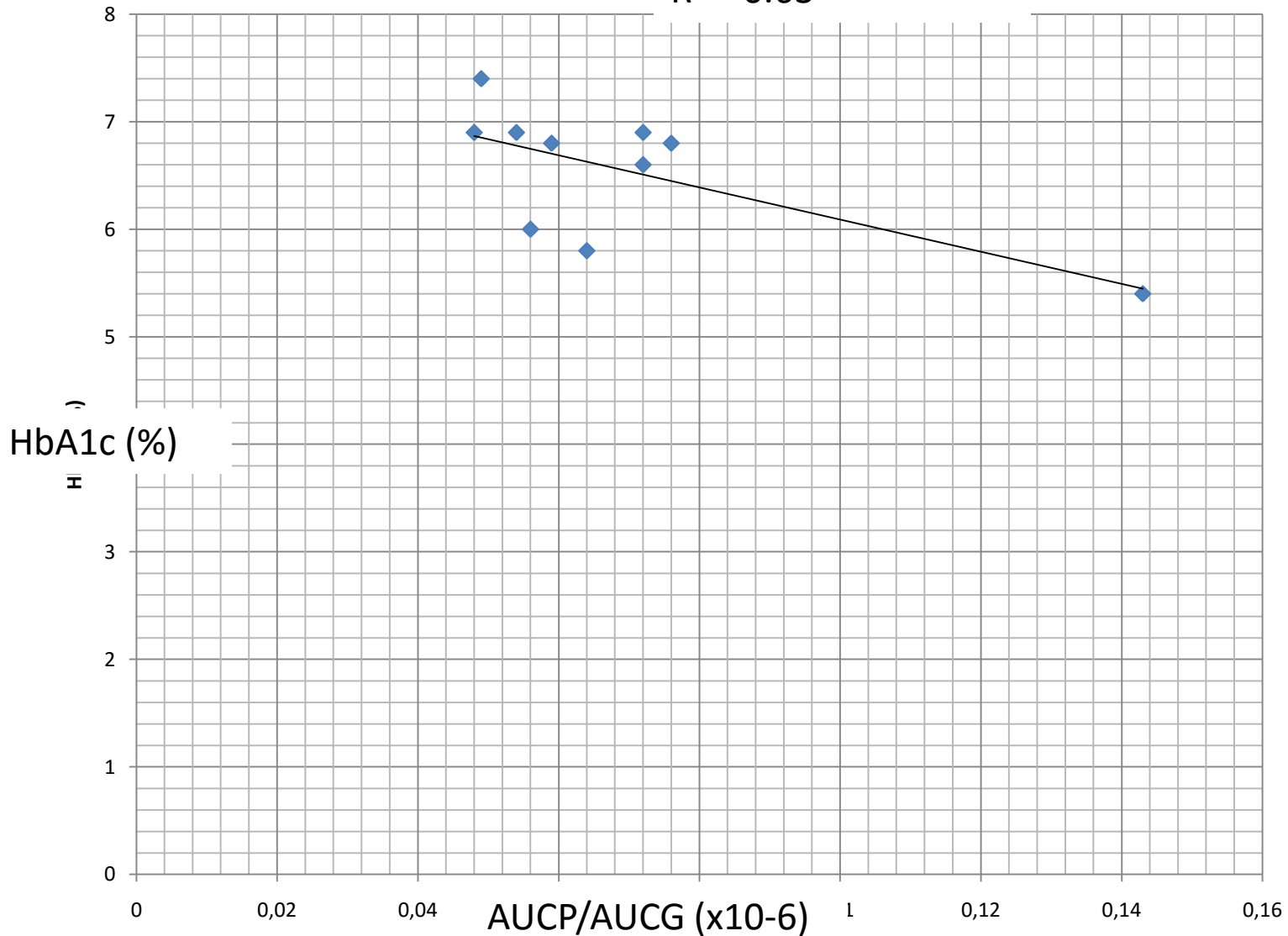
RESULTS



CORRELATION(HbA1c and AUCP/AUCG)

P = 0.04

R = -0.63



CONCLUSION

After 8 weeks of add-on therapy, Spirulina

1. Decreased insulin sensitivity
2. Increased insulin secretion
3. Improved the lipid profile
4. Reduced HbA1c%
5. Reduced blood glucose

RECOMMENDATIONS

- TO CLINICIANS

That *Spirulina platensis* be used as a food supplement, in association with insulin sensitizers and other approved methods to manage patients with type 2 diabetes.

- TO RESEARCHERS

That a randomized controlled study be carried out in a similar population, with a longer duration as well different HbA1c groups.

RECOMMENDATIONS

- TO THE MINISTRY OF AGRICULTURE AND RURAL DEVELOPEMENT

That Spirulina growth and culture training programs be encouraged in Cameroon to increase Spirulina availability for patients with diabetes.

RESUME

- Le traitement du diabète de type 2 et des comorbidités constitue un important fardeau
- les médicaments chimiques entraînent des effets indésirables non négligeables.
- Besoin du recours aux produits naturels ayant des bénéfices additionnels.
- *Spirulina platensis* est aujourd'hui un aliment prometteur qui possède diverses propriétés.

OBJECTIF

Evaluer l'effet de la spiruline sur:

- L'insulinosensibilité
- L'insulinosécrétion
- La glycémie
- L'hémoglobine glyquée
- Le profil lipidique

METHODES

- TYPE D'ETUDE: Experimentale, type avant-apres
- TAILLE D'ECHANTILLON: 10 participants
- INTERVENTION: 10g dose journaliere de la Spiruline pendant 8 semaines.
- EXPLORATIONS:
 - clamp euglycémique hyperinsulinémique.
 - Repas test .
 - Dosages biologiques (peptide-C, HbA1c, profile lipidique, glucose).
- MONITORING: ALAT, créatininémie chaque mois

RESULTATS

- Sexe ratio 1 :1, âge médian de 54 ans
- Baisse des pressions artérielles systolique et diastolique
- Augmentation de mass grasse, et une baisse de la masse maigre.
- Baisse des TG, CT, LDL-C, et l'index atherogénique
- Amelioration de la secretion de peptide C et l'activite global des cellules bêta.
- Baisse de la sensibilité a l'insuline.

CONCLUSION

La Spiruline améliore le profilé métabolique des patients diabétiques de type 2 Camerounais

RECOMMENDATIONS

- Aux Cliniciens

Associer de la spiruline comme supplement alimentaire pour la prise en charge des malades diabetiques.

- Aux Chercheurs

Mener une esaie clinique randomize avec la spiruline

- Ministere de l'agriculture:

Encourager la culture de la spiruline.

APPRECIATION

MERCI DE VOTRE ATTENTION

- Please , I have a major problem with my conclusion.
- Prof Mbanya asked me to conclude by stating and answering my 3 spc objectives. I have difficulties doing that bc of the manner I used in presenting the objectives.