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REGULAR ARTICLE

Investigation of anti-hyperglycemic effect in juice and lyophilized forms of *Morinda citrifolia*

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Abstract

Noni (*Morinda citrifolia*) has extensive utilization by people worldwide in traditional medicine and has also several pharmacological activities described. Accordingly, this study evaluated the anti-hyperglycemic effect of Noni, in the form of juice or lyophilized commercial product, in rats subjected to glucose overload. Noni juice and lyophilized noni, at the doses used, had no anti hyperglycemic effect. Further studies with higher doses or following other experimental protocols will be needed to evaluate this effect.

Key words: *Morinda citrifolia*, anti-hyperglycemic effect, Noni

Introduction

Medicinal plants remained as an alternative form of treatment in many parts of the world. According to World Health Organization (WHO), due to poverty and poor access to modern medicine, about 65 to 80% of the world population depends largely on plants as a primary form of health care (Calixto, 2005). In this social context, medicinal plants and herbal acquire importance as therapeutic agents.

Morinda citrifolia, commonly known as Noni, has a long history of medicinal use in Polynesia, China, India, Australia and Hawaii. And recently, it has become a food supplement in the form of juice, quite consumed in the United States, Japan and most of Europe. The growth in popularity can be attributed in part to its power "cure-all". This juice has been used in folk medicine for treating diseases and / or disorders such as diabetes, diarrhea, pain, hypertension, arthritis, stress and cancer (Wang et al., 2008).

Noni grows both in forests and in rocky or sandy areas. It is tolerant to saline soils and some drought conditions, and is therefore found in a wide variety of habitats, including volcanic terrain or ground limestone. It can grow up to 9 feet tall and has broad leaves, simple, dark green, wrinkled with veins. The plant flowers and fruits all year round. Its flowers are small and white. Its fruit contains many seeds and gives off a strong odor when harvested, so it is sometimes described as cheese fruit or vomit fruit (McClatchey, 2002).

The noni juice is in high demand in alternative medicine, because its likely effects antioxidants and anti-inflammatories to combat different types of diseases. However, the scientific evidence for the benefits of this fruit juice are limiting. The increase products as dietary supplements suggest urgent inquiries regarding the quality control purposes (Correia, 2010).

In noni juice, Hirazumi and Furusawa (1999) identified polysaccharides rich in substances with anti-tumor activity for Lewis carcinoma in experiments with rats. According to the study, noni juice boosts the immune system, consequently inhibiting tumor growth. The compounds with biological activity were identified in the study of Su et al. (2005). These compounds showed antioxidant activity in vitro and were identified in extracts of noni. Other bioactive compounds were isolated and identified in the noni plant, anthraquinones, glycosides flavonol, iridoid glycosides and lipo-glycosides were the major chemical constituents found in noni plant (Su et al., 2005).

Lerco et al. (2003) investigated the effect of *Morinda citrifolia* juice on blood glucose levels of diabetic rats alone or in combination with insulin, and observed that there was a synergistic action of fruit juice of *Morinda citrifolia* with insulin. Nayak

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et al. (2010) in a very recent study, proved the hypoglycemic and hepatoprotective properties of noni juice fermented in diabetes-induced rats.

ANVISA (National Sanitary Surveillance Agency) has not recommended the marketing of noni in Brazil, there is not yet enough scientific information to ensure the consumption of noni, however is known to many that even without approval from ANVISA, the juice is sold clandestinely and by the interest of many possible benefits that this fruit may have are growing (Barros, 2009).

Due to the large popular use of noni as natural medicine, it become necessary to conduct research for proving their biological effects, this study aimed to evaluate the anti-hyperglycemic effect, in the form of juice or commercial lyophilized product in rats with glucose overload.

Materials and Methods

Ethical aspects

The project was approved by the Ethics Committee for Animal Experiments – CEEA/UFPI, with the report number 07/2010.

Plant material

The fruits of *Morinda citrifolia* were collected on the campus of the Federal University of Piauí. The Noni juice was prepared as it is popularly used by dissolving the fruit in grape juice in concentration 830 g/L.

Chemical and drugs

The following drugs and chemicals were used: Lyophilized Noni (Natural Viva®, Brazil), Metformin (Neo Química®, Brazil). All drugs were dissolved in distilled water. The concentration of lyophilized Noni was 400 mg/kg, while Metformin had it concentration set at 500 mg/kg.

Animal model

Female Wistar albino rats, weighting 150–200 g, coming from the biotherium of the Department of Biophysics and Physiology (CCS/UFPI), maintained under controlled temperature (24 ± 2°C) and 12–12 h light dark cycle and allowed free access to food and water. After a fasting period of 10 h, they were acclimatized to the test environment for 2 h before the experimentation.

Treatments

The animals were orally treated with 5 ml/kg of water (control group,C,n=8), Noni juice (200 mg/kg, NJ, n=8), lyophilized Noni (400 mg/kg, LN, n=8) and Metformin (500 mg/kg,M, n=8). After thirty minutes, the animals received by gavage solution of glucose (10 g/ kg). Determined blood glucose (mg/dL) before and 30, 60 and 120 minutes after the glucose overload.

Analysis of blood glucose levels

Whole blood was sampled from the tail vein of rats, and the blood sample was analyzed using the glucose oxidase method, which utilizes a blood glucose sensor strip (Accu-Chek®).

Statistical analysis

The data were expressed as mean ± standard error of the mean (SEM). The values were compared by one-way ANOVA followed by Tukey's posttest. The significance level was set at 5% ($p < 0.05$).

Results and Discussion

Table 1 shows the mean blood glucose of Wistar rats during the experiment. There was no significant difference between the initial blood glucose among the groups (Figure 1). After 30 minutes there was a significant reduction ($p < 0.05$) of blood glucose in group M (metformin 500 mg/kg) compared to group C (control group), but not with respect to NJ (noni juice 200 mg/kg) and LN (lyophilized noni 400 mg/kg) (Figure 2). No significant differences were observed among the groups after 60 and 120 minutes after administration of the glucose solution (Figure 3, 4).

Table 1. Mean blood glucose (mg/dl) Wistar rats treated with water (control group, C), noni juice 200 mg/kg (NJ), lyophilized noni 400 mg/kg (LN) and metformin 500 mg/kg (M).

	0	30 min	60 min	120 min
C	93.13 ± 4.14	246.50 ± 34.49	134.71 ± 9.28	183.88 ± 37.43
NJ	100.43 ± 3.33	193.57 ± 9.75	155.14 ± 8.71	143.0 ± 6.07
LN	97.88 ± 3.82	200.25 ± 16.76	163.00 ± 11.37	142.5 ± 5.98
M	91.15 ± 1 55	134.71 ± 9.28	122.86 ± 5.47	119.14 ± 7.71

Each value represents the mean mean ± standard error of the mean (SEM).

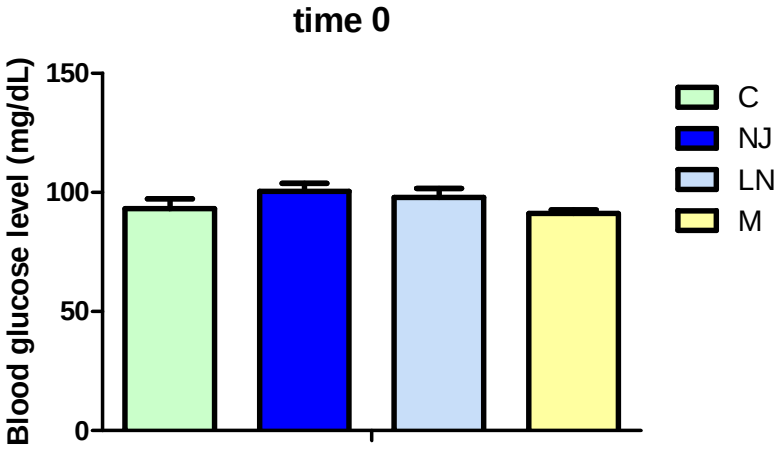

Figure 1. Mean blood glucose (mg/dl) Wistar rats treated with water (control group, C), noni juice 200 mg/kg (NJ), lyophilized noni 400 mg/kg (LN) and metformin 500 mg/kg (M) before glucose overload (t = 0).

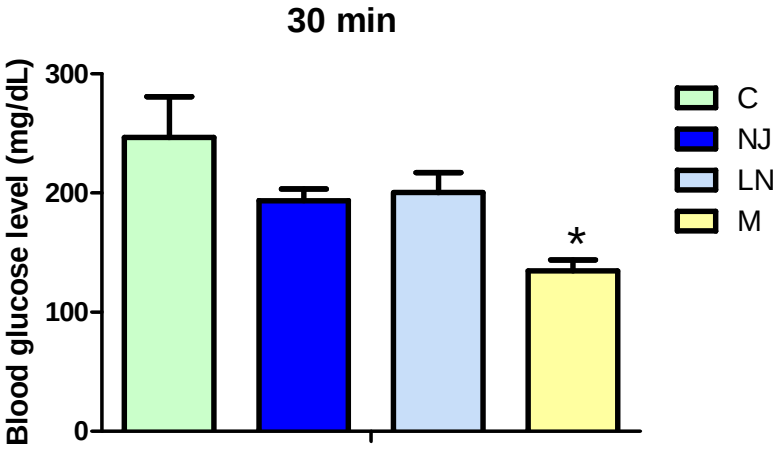

Figure 2. Mean blood glucose (mg/dl) Wistar rats treated with water (control group, C), noni juice 200 mg/kg (NJ), lyophilized noni 400 mg/kg (LN) and metformin 500 mg/kg (M) 30 minutes after glucose overload (t = 30). * $p<0.05$ versus control group.

M. citrifolia, also known as noni, is one of the most important traditional Polynesian medicinal plants and has been heavily promoted for a wide range of uses; from arthritis and burns to circulatory weakness, diabetes**,** cancer, skin inflammation, and wounds (Lee, 2012).

Both the juice as a lyophilized form have high content of phenolic compounds and vitamin C, which appear to contribute to the beneficial health effects, and are composed primarily of carbohydrates and polysaccharides, especially pectin (Correia et al., 2011). Its mechanism of action, remains unknown, includes possible activities antioxidant, anti-angiogenic and anti-tumor (Su et al., 2005). The noni has been advisable in diabetes by stimulating the cellular

regeneration of the Langhans cells, through pro-xeronine (Wang et al., 2008).

The initial glucose similar between groups showed that the glycemic conditions of all animals were previously normal and similars. After 30 minutes of administration of glucose load, occured a significant glucose reduction in group M than in group C, but not regarding NJ and LN. Metformin is known to be an antihiperglicemiante oral, of the biguanide class, which operates through the following mechanisms: inhibiting hepatic gluconeogenesis, enhances the sensitivity of peripheral tissues to insulin and reduced glucose turnover in splanchnic tissue (Nayak, 2010). Also stimulates the metabolism of non-oxidative glucose intestinal cells, thus increasing the production of lactic acid, presents an anorectic effect further and reduces triglycerides and plasma levels of plasminogen activator inhibitor, a prothrombotic substance. Blood glucose usually is reduced by around 20% with treatment alone. NJ and LN groups did not show a significant reduction of blood glucose, refuting the anti-hipergicemiante effect of *Morinda Citrifolia* in the doses used and with this experimental protocol.

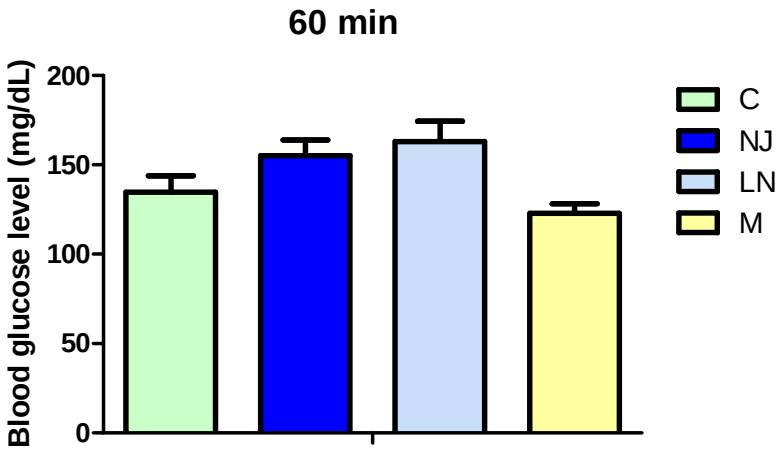

Figure 3. Mean blood glucose (mg/dl) Wistar rats treated with water (control group, C), noni juice 200 mg/kg (NJ), lyophilized noni 400 mg/kg (LN) and metformin 500 mg/kg (M) 60 minutes after glucose overload (t = 60).

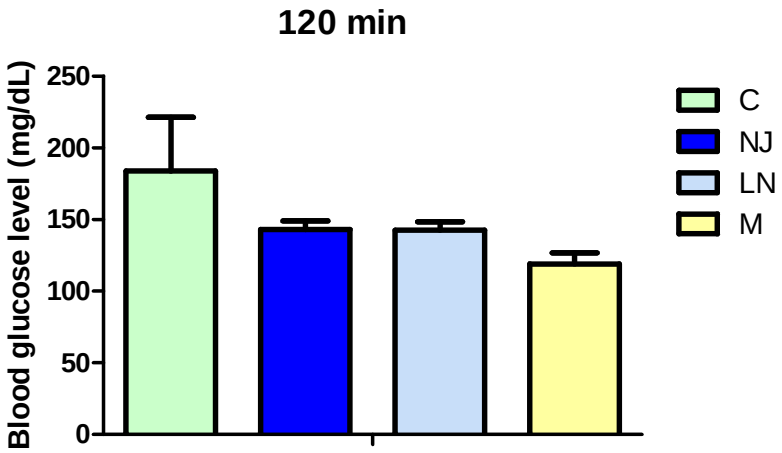

Figure 4. Mean blood glucose (mg/dl) Wistar rats treated with water (control group, C), noni juice 200 mg/kg (NJ), lyophilized noni 400 mg/kg (LN) and metformin 500 mg/kg (M) 120 minutes after glucose overload (t = 120).

However, no significant differences were observed between groups at the time of 60 and 120 minutes after the administration of the glucose solution, showing that with the passage of time glucose values of the groups became similar, regardless of treatment.

Conclusion

The results indicate that noni juice and lyophilized noni, at the doses used, did not show anti-hyperglycemic effect. Further studies with higher doses or following other experimental protocols, become necessary.

Acknowledgments

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