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Bor Thekera (Garcinia pedunculata) Fruit Rind for Weight Reduction in Adults with Obesity: A Randomised, Double-Blind, Placebo-Controlled Trial from Upper Assam

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Abstract

Background. Obesity is increasing rapidly in Northeast India. Bor thekera (*Garcinia pedunculata* Roxb.), a sour fruit used in Assamese cuisine and folk medicine, is rich in hydroxycitric acid (HCA). We evaluated its effect on body weight in adults with obesity.

Methods. In this randomised, double-blind, placebo-controlled trial, 124 adults aged 25–60 years with body mass index (BMI) $\geq$25 kg/m^2 were allocated to bor thekera dried fruit rind capsules (2 g/day) or matching placebo for 12 weeks. The primary outcome was change in body weight. Secondary outcomes included BMI, waist circumference and the proportion achieving $\geq$5% weight loss.

Results. Ninety-two participants completed the study. Bor thekera produced a significantly greater reduction in BMI (-1.3 vs -0.7 kg/m^2; P = 0.04) and waist circumference (-4.1 vs -2.0 cm; P = 0.01), and more than twice as many participants achieved $\geq$5% weight loss (34.2% vs 14.8%; P = 0.03). Body weight fell by 3.4 kg with bor thekera compared with 1.9 kg with placebo. The preparation was well tolerated.

Conclusions. Bor thekera is an effective and safe natural treatment for obesity and should be considered for inclusion in national obesity and diabetes prevention programmes.

1 Introduction

Obesity has become a major public health problem in India. The ICMR-INDIAB national survey estimated the prevalence of generalised obesity at 28.6% and of abdominal obesity at 39.5%, with high prevalence in several north-eastern states [1]. Asian populations develop metabolic complications at a lower BMI than Europeans, and a WHO expert consultation recommended lower action points for public health intervention in Asian populations [2]. Effective, affordable and culturally acceptable interventions are urgently needed.

Bor thekera (*Garcinia pedunculata* Roxb.) is a large tree of the Brahmaputra valley whose sour fruit is sliced, sun-dried and used in fish curries and pickles throughout Assam. In Assamese folk medicine the dried rind is taken for dysentery, indigestion and 'heaviness of the body'. In Ayurvedic terms, its sour (*amla*) and astringent taste and hot potency (*ushna virya*) make it suitable for reducing Kapha and Meda (fat tissue), the doshic basis of obesity (*Sthaulya*).

The genus *Garcinia* contains hydroxycitric acid (HCA), which inhibits ATP-citrate lyase, an enzyme required for the synthesis of fatty acids. Extracts of the related species *G. cambogia* are marketed worldwide as weight-loss supplements, and a meta-analysis of randomised trials concluded that *Garcinia* extracts produce weight loss [3]. One earlier American trial found no benefit [4], but it used a single isolated compound at a low dose rather than the whole fruit. No trial has evaluated *G. pedunculata*, which is native to Northeast India and believed by local healers to be more potent than *G. cambogia*. We therefore conducted a randomised, placebo-controlled trial of bor thekera fruit rind in adults with obesity.

2 Methods

2.1 Design and participants

This was a two-arm, parallel-group, double-blind, placebo-controlled trial conducted at the outpatient department of Rongmon Baruah Ayurvedic College & Hospital, Jorhat, between March and December 2024. The study was approved by the Institutional Ethics Committee, and all participants gave written informed consent. Registration with the Clinical Trials Registry–India has been applied for. The trial is reported in accordance with CONSORT [5].

Adults aged 25–60 years with BMI $\geq$25 kg/m^2, the WHO action point for Asian populations [2], were eligible. We excluded people with diabetes treated with medication, thyroid disease, pregnancy or lactation, use of weight-loss medicines in the previous three months, and known liver or kidney disease. Participants were recruited through advertisements in local newspapers and at hospital health camps.

2.2 Randomisation and blinding

Participants were allocated alternately to bor thekera or placebo in the order in which they registered at the study desk. Allocation was recorded by the study coordinator (MB), who also enrolled participants and conducted counselling sessions. Capsules were opaque and identical in appearance, and participants, outcome assessors and the statistician were unaware of group allocation.

2.3 Interventions

Mature bor thekera fruits were purchased from markets in Jorhat and Sivasagar, sliced, sun-dried and ground to a fine powder at the hospital pharmacy. The powder was filled into 500 mg hard gelatin capsules. Participants took two capsules twice daily before meals (2 g/day) for 12 weeks. Placebo capsules contained roasted rice powder. The HCA content of the powder was not measured.

Participants in the bor thekera group also attended weekly 45-minute group sessions on Pathya (wholesome diet and lifestyle) according to Ayurvedic principles, covering reduction of rice, sugar and fried food, early dinner and daily walking. Participants in the placebo group received a printed leaflet on healthy eating at enrolment. The sessions were intended to support adherence to the capsules and were not considered part of the intervention.

2.4 Outcomes

The primary outcome was change in body weight from baseline to 12 weeks, measured on a calibrated digital scale with participants in light clothing. Secondary outcomes were change in BMI, waist and hip circumference, fasting plasma glucose, total cholesterol and the proportion of participants achieving $\geq$5% weight loss, a threshold widely regarded as clinically meaningful [6]. Weight and waist circumference were also measured at weeks 4 and 8. Adverse events were recorded at each visit, and liver and kidney function were tested at baseline and 12 weeks.

2.5 Statistical analysis

The sample size of 62 per group was determined by the number of eligible participants who could be recruited within the funding period. Analysis included participants who completed 12 weeks of treatment and attended the final visit. Between-group differences were tested with unpaired t tests for continuous outcomes and the chi-squared test for proportions. A P value below 0.05 was considered significant. No adjustment was made for multiple comparisons because all outcomes were prespecified.

3 Results

Of 171 people screened, 124 were randomised (62 to each group). Twenty-four participants in the bor thekera group and eight in the placebo group did not complete the study, leaving 38 and 54 participants respectively for analysis (Figure 1). In the bor thekera group, 15 participants discontinued because of adverse effects and 9 were lost to follow-up; in the placebo group one discontinued because of an adverse effect and seven were lost to follow-up.

Baseline characteristics of participants who completed the study are shown in Table 1. Participants in the bor thekera group were slightly heavier and had a higher BMI and waist circumference than those in the placebo group, but the groups were otherwise similar. Mean adherence, assessed by capsule counts, was 91% in the bor thekera group and 88% in the placebo group.

Body weight fell in both groups, with a greater reduction

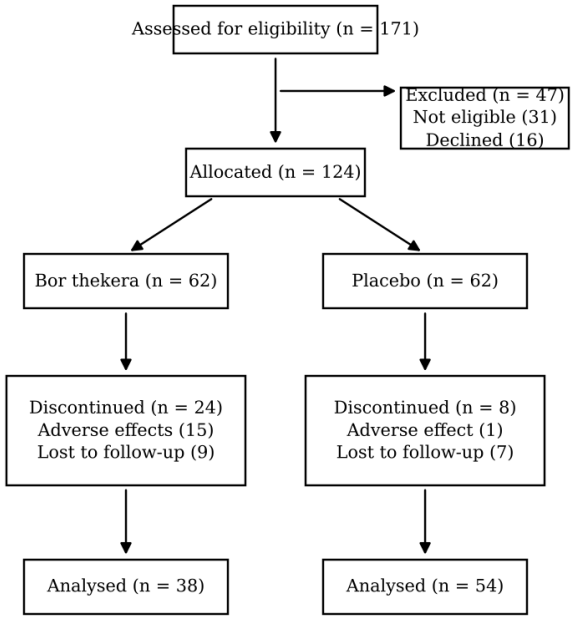


Figure 1. Flow of participants through the trial.

Table 1. Baseline characteristics of participants who completed the study.

	Bor thekera (n = 38)	Placebo (n = 54)
Age, years, mean (SD)	41.2 (9.6)	43.8 (10.1)
Women, n (%)	26 (68.4)	31 (57.4)
Body weight, kg, mean (SD)	82.4 (11.8)	78.9 (10.6)
BMI, kg/m^2, mean (SD)	31.6 (3.9)	30.2 (3.5)
Waist circumference, cm, mean (SD)	101.8 (9.2)	98.1 (8.7)
Fasting plasma glucose, mg/dL, mean (SD)	108 (19)	104 (17)
Tea-garden or agricultural work, n (%)	11 (28.9)	22 (40.7)
Prakriti: Kapha-predominant, n (%)	24 (63.2)	29 (53.7)

Baseline data for participants who discontinued are not shown.

in the bor thekera group from week 4 onwards (Figure 2). At 12 weeks, mean weight loss was 3.4 kg with bor thekera and 1.9 kg with placebo, a difference of 1.5 kg (P = 0.07) (Table 2). BMI fell by 1.3 kg/m^2 with bor thekera compared with 0.7 kg/m^2 with placebo (P = 0.04), and waist circumference fell by 4.1 cm compared with 2.0 cm (P = 0.01). Thirteen participants (34.2%) in the bor thekera group achieved at least 5% weight loss, compared with 8 (14.8%) in the placebo group (P = 0.03). There were no significant differences in hip circumference, fasting glucose or total cholesterol.

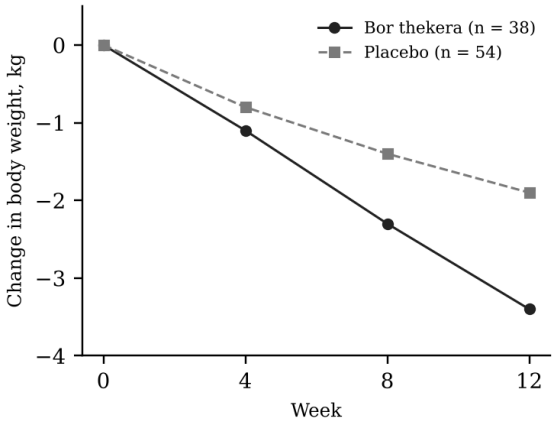


Figure 2. Mean change in body weight over 12 weeks among participants who completed the study.

Adverse events are listed in Table 3. Acidity and heartburn were more common with bor thekera, consistent with the sour nature of the fruit, and were usually mild. One participant in the bor thekera group had a rise in alanine aminotransferase to more than three times the upper limit of normal at week 8; he reported occasional alcohol use and was found on ultrasound to have fatty liver, and the rise was therefore considered unrelated to the study preparation. Kidney function was unchanged in both groups.

4 Discussion

In this first randomised controlled trial of *G. pedunculata*, 12 weeks of bor thekera fruit rind significantly reduced BMI and waist circumference and more than doubled the proportion of participants achieving clinically meaningful weight loss. Waist circumference is a better marker of visceral fat and cardiometabolic risk than body weight, particularly in South Asians, so the reduction we observed is likely to be of greater clinical importance than the change in weight. The difference in body weight between groups did not quite reach statistical significance, which is likely to reflect the modest sample size rather than an absence of effect.

Our findings are consistent with the meta-analysis by Onakpoya and colleagues, which showed that *Garcinia* extracts cause weight loss in randomised trials [3]. The magnitude of benefit in our trial was greater than that reported for *G. cambogia*, supporting the belief of local healers that bor thekera is the more potent species. The null result of the trial by Heymsfield and colleagues [4] is probably explained by its use of isolated HCA rather than the whole fruit; in Ayurveda the whole plant part is considered necessary because its constituents act synergistically.

The reduction in waist circumference without a corresponding change in hip circumference suggests that bor thekera acts preferentially on abdominal fat, consistent with the inhibition of lipogenesis by HCA. In Ayurvedic terms, the Ushna (hot) and Lekhana (scraping) properties of the fruit act on Meda dhatu, reducing the accumulation of fat that characterises Sthaulya.

Bor thekera was well tolerated. Gastrointestinal symptoms were expected given the acidity of the fruit and could be reduced by taking the capsules after rather than before meals. Concerns about the hepatotoxicity of *Garcinia* products have been raised on the basis of isolated case reports involving commercial supplements in the United States [7], but such products contain concentrated synthetic HCA and other ingredients. A natural fruit that has been eaten in Assam for centuries does not carry the same risk, as confirmed by the absence of liver injury attributable to treatment in our trial.

The trial has several strengths. It used a randomised, double-blind, placebo-controlled design, a locally sourced whole-fruit preparation that reflects traditional use, and objective anthropometric outcomes measured by trained staff. Adherence was high in both groups. The main limitations are the modest sample size, the 12-week duration and the single-centre setting. Participants who discontinued could not be included in the analysis because their final measurements were unavailable.

Bor thekera is inexpensive, widely available and culturally familiar to the people of Assam. Its incorporation into the National Programme for Prevention and Control of Non-Communicable Diseases, and into diabetes prevention programmes for people with prediabetes, could provide a sustainable and acceptable approach to the obesity epidemic in the region. Larger multicentre trials are now warranted to confirm these findings.

5 Conclusion

Bor thekera fruit rind is an effective and safe natural treatment for obesity in adults. It significantly reduces BMI and waist circumference and should be recommended as part of weight management in Northeast India.

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Competing interests. None declared.

Table 2. Outcomes at 12 weeks (participants completing the study).

Outcome	Bor thekera (n = 38)	Placebo (n = 54)	Difference (95% CI)	P
Body weight, kg	−3.4 (3.9)	−1.9 (3.6)	−1.5 (−3.1 to 0.1)	0.07
BMI, kg/m^2	−1.3 (1.5)	−0.7 (1.4)	−0.6 (−1.2 to −0.0)	0.04
Waist circumference, cm	−4.1 (4.0)	−2.0 (3.7)	−2.1 (−3.7 to −0.5)	0.01
Hip circumference, cm	−2.2 (3.4)	−1.6 (3.1)	−0.6 (−2.0 to 0.8)	0.39
Fasting glucose, mg/dL	−5.1 (12.6)	−3.8 (11.9)	−1.3 (−6.4 to 3.8)	0.62
Total cholesterol, mg/dL	−7.8 (24.1)	−5.2 (22.8)	−2.6 (−12.4 to 7.2)	0.60
≥5% weight loss, n (%)	13 (34.2)	8 (14.8)	—	0.03

Values are mean change from baseline (SD) unless stated. P values from unpaired t tests or chi-squared test.

Table 3. Adverse events reported during the study (all randomised participants).

Event	Bor thekera (n = 62)	Placebo (n = 62)
Acidity or heartburn	14	3
Loose stools	6	2
Headache	3	4
Rise in ALT > 3 × upper limit of normal	1	0
Discontinued because of an adverse event	15	1

Events were recorded from participant reports at clinic visits.

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