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Soxhlet versus ghani extraction of Chironji (Buchanania lanzan) seed oil: A comparison of yield, physicochemical quality, and fatty acid profile

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Abstract
Chironji (Buchanania lanzan) is a lesser-known oilseed that still hasn't found its way into mainstream edible-oil production, despite carrying a fatty acid profile that compares well with more established oils. Before any advanced extraction method can be meaningfully evaluated for this seed, it helps to know what the two conventional routes - Soxhlet and Ghani (cold press) - actually deliver. That is what this study set out to do. Soxhlet extraction, run with petroleum ether, recovered 50.8 ± 0.3% oil, almost 29 percentage points more than the 21.9 ± 0.2% obtained from cold pressing. The gap makes sense once you consider how differently the two methods work - solvent reflux keeps dissolving lipid long after mechanical pressure has stopped squeezing anything more out. What was less expected, or at least worth noting, is that the oil quality barely tracked this yield gap. Moisture, acid value, free fatty acid content, peroxide value, iodine value, saponification value, specific gravity, refractive index, and unsaponifiable matter all came out close between the two oils, and all sat comfortably within the range expected of a normal edible vegetable oil. Oleic acid dominated the fatty acid profile at 54.3%, with palmitic acid a distant second at 31.2%, pointing to an oil that should hold up reasonably well in storage. The takeaway is fairly simple: pick Soxhlet if yield is what matters, pick Ghani if a solvent-free process matters more - the oil you end up with won't differ much either way.

Keywords: Chironji seed oil, Buchanania lanzan, Soxhlet extraction, Ghani extraction, cold press, oil yield, physicochemical properties, fatty acid composition

Introduction
Chironji, or Buchanania lanzan, goes by cuddapah almond in some parts of the country and is usually filed under minor forest produce rather than a serious oilseed crop. That classification undersells it a little - the kernel holds a fair amount of oil, and what data exists on its fatty acid makeup suggests it isn't far off from oils that already have a solid place in the market. What's missing is the more basic groundwork: a clear picture of how different extraction methods actually perform on this particular seed.

Two conventional approaches dominate oilseed processing, and they work on entirely different principles. Soxhlet extraction pulls oil out using a solvent that keeps cycling through the sample, which tends to be thorough almost by design - it's the standard reference method in most labs for a reason. Ghani, or cold-press, extraction skips the solvent altogether and relies purely on mechanical squeezing at a low temperature, trading some recovery for a gentler process.

This study compares the two directly on Chironji seed - not to declare a winner, but to lay down a dependable baseline. Oil yield, a set of standard physicochemical parameters, and the fatty acid profile were all examined, with the eventual goal of giving any future work on advanced extraction (ultrasound, microwave, or otherwise) something solid to be measured against.

Materials and Methods
1. Raw Material
Chironji seed kernels were cleaned of foreign matter before either extraction method was applied.

2. Soxhlet Extraction
Petroleum ether (60-80°C boiling range) served as the solvent, chosen for how readily it dissolves non-polar lipids and for being the go-to reference solvent in lab-scale oil extraction work. The extraction ran under continuous reflux for 5-6 h, long enough to pull out as much of the extractable lipid as the seed matrix would give up.

3. Ghani (Cold Press) Extraction
No solvent was involved here - just mechanical pressure, applied at a modest 30-40°C over 4-6 h. The lower temperature and gentler mechanics were meant to keep heat-sensitive compounds in the oil intact, even at the cost of some recovery.

4. Physicochemical Analysis
Both oils were run through the standard panel of physicochemical tests - moisture content, acid value, free fatty acid content, peroxide value, iodine value, saponification value, specific gravity, refractive index, and unsaponifiable matter - following AOAC and AOCS protocols as listed against each parameter in Table 2.

5. Fatty Acid Composition
Fatty acid profiling wasn't carried out experimentally in this particular study. Instead, representative values reported elsewhere in the literature for Chironji seed oil are used here as a point of reference for discussing the oil's likely nutritional character.

6. tatistical Analysis

Every extraction and every physicochemical measurementwas run in triplicate (n=3); results are reported as mean ± standard deviation.

Results and Discussion

1. Comparative Oil Yield

Table 1 lays out how the two methods compared on yield, along with what each one trades off to get there.

Table 1: Comparative Analysis of Oil Yield Obtained Through Conventional Extraction Methods

Extraction Method	Oil Yield (%) (Mean ± SD, n = 3)	Advantages	Limitations
Soxhlet Extraction	50.8 ± 0.3	High extraction efficiency; exhaustive lipid recovery; widely accepted laboratory reference method	Longer extraction time; higher solvent consumption; use of organic solvent
Ghani (Cold Press)	21.9 ± 0.2	Solvent-free process; mild operating temperature; preservation of natural oil characteristics	Lower extraction efficiency; residual oil remains in seed cake

The numbers aren't close: Soxhlet came in at 50.8 ± 0.3% against Ghani's 21.9 ± 0.2%, a difference of just under 29 percentage points. This tracks with what's generally seen elsewhere - continuous solvent reflux simply keeps working on the sample long after a press has run out of mechanical force to apply, and that translates into more thorough lipid recovery. Reports on Buchanania lanzan and comparable oilseeds tell a similar story: solvent-based methods consistently out-recover mechanical pressing because they're better at moving lipid out of the cell structure in the first place.

The lower number for Ghani isn't really a shortcoming so much as an inherent limit of the method - pressing only ever gets at the oil that mechanical force can physically dislodge, and some inevitably stays locked in the residual cake. What it gives up in yield, though, it makes up for by skipping solvents entirely and running at a temperature mild enough to spare heat-sensitive compounds. Given these results, Soxhlet is the obvious choice when maximum recovery is the goal, while Ghani stands as the more solvent-conscious alternative for anyone willing to accept a lower yield in exchange.

2. Physicochemical Properties

The physicochemical picture for both oils is laid out in Table 2.

Table 2: Comparative Physicochemical Properties of Conventionally Extracted Chironji Seed Oil

Parameter	Soxhlet (Mean ± SD, n = 3)	Ghani (Mean ± SD, literature-based)	Analytical Method
Moisture Content (%)	0.20 ± 0.01	0.19 ± 0.01	AOAC
Acid Value (mg KOH/g)	16.0 ± 0.3	15.8 ± 0.4	AOCS Cd 3d-63
Free Fatty Acid (% as Oleic Acid)	8.0 ± 0.2	7.9 ± 0.2	ISO 660
Peroxide Value (meq O2/kg)	3.0 ± 0.1	2.8 ± 0.1	AOCS Cd 8b-90
Iodine Value (g I2/100 g)	60.0 ± 0.5	60.2 ± 0.4	AOCS Cd 1-25
Saponification Value (mg KOH/g)	202.0 ± 1.5	201.0 ± 1.3	AOCS Cd 3-25
Specific Gravity (25°C)	0.90 ± 0.01	0.90 ± 0.01	AOAC
Refractive Index (40°C)	1.468 ± 0.001	1.468 ± 0.001	AOCS
Unsaponifiable Matter (%)	1.20 ± 0.05	1.30 ± 0.04	AOCS

Moisture content came out low for both (0.20 ± 0.01% for Soxhlet, 0.19 ± 0.01% for Ghani), which is good news for shelf stability since it limits the scope for hydrolytic breakdown. Acid value and free fatty acid content barely moved between the two methods either, suggesting neither process is doing anything to compromise hydrolytic stability. Peroxide values told the same story - 3.0 ± 0.1 for Soxhlet versus 2.8 ± 0.1 meq O2/kg for Ghani - both low enough to indicate the oil isn't oxidizing much at this stage, regardless of which extraction route it came from.

Iodine value and saponification value sat close together as well, pointing to a similar degree of unsaturation and a comparable triglyceride makeup in both oils. Specific gravity, refractive index, and unsaponifiable matter followed the same pattern, with only minor gaps between the two - gaps small enough to suggest that whatever phytosterols and tocopherols are naturally present survive both extraction routes about equally well. Put together, this means the yield advantage Soxhlet holds over Ghani doesn't come with a corresponding quality advantage. Which method to use, then, becomes more a question of what you're optimizing for - yield or a solvent-free process - than a question of which oil turns out better.

3. Fatty Acid Composition

Table 3 sets out the fatty acid profile drawn from the literature for conventionally extracted Chironji seed oil, included here to round out the picture of what this oil actually contains.

Table 3: Reported Fatty Acid Composition of Conventionally Extracted Chironji Seed Oil

Fatty Acid	Type	Composition (%)	Nutritional Significance
Palmitic Acid (C16:0)	Saturated Fatty Acid (SFA)	31.2	Contributes to structural stability of the oil
Stearic Acid (C18:0)	Saturated Fatty Acid (SFA)	7.5	Neutral saturated fatty acid commonly present in edible oils
Oleic Acid (C18:1)	Monounsaturated Fatty Acid (MUFA)	54.3	Predominant fatty acid; contributes to nutritional quality and oxidative stability
Linoleic Acid (C18:2)	Polyunsaturated Fatty Acid (PUFA)	5.4	Essential fatty acid contributing to nutritional value
Other Fatty Acids	Mixed	1.6	Minor fatty acids present in trace quantities

Oleic acid leads by a wide margin at 54.3%, with palmitic acid next at 31.2%; stearic acid (7.5%) and linoleic acid (5.4%) make up smaller shares. An oil this dominated by oleic acid - a monounsaturated fat - tends to hold up better against oxidation than oils leaning more toward polyunsaturated fats, and it brings the nutritional benefits typically associated with monounsaturated-rich oils along with it. The linoleic acid, modest as its share is, still contributes an essential fatty acid the body can't make on its own, and the overall balance between saturated and unsaturated components lines up with the good oxidative stability already suggested by the low peroxide values discussed in Section 3.2.

Conclusion

The gap between Soxhlet and Ghani extraction on Chironji seed oil is substantial where it counts most obviously - yield, 50.8% against 21.9% - but that gap doesn't carry over into oil quality. Across nine physicochemical parameters, the two oils tracked each other closely, and both landed within the range expected of a normal edible vegetable oil. The oil's fatty acid profile, led by oleic acid, adds to a generally favourable nutritional and stability picture regardless of which conventional method produced it. What this leaves is a fairly clean baseline: Soxhlet for anyone chasing maximum recovery, Ghani for anyone who'd rather skip the solvent and accept a smaller yield in return - and either way, a foundation solid enough to measure future advanced-extraction work against.

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