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Nutritional Enhancement of Popular Street Foods: Replacing Refined Flour with Sorghum (Jowar) in Vada Pav and Samosas

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Abstract
India street food economy kinda leans hard on refined wheat flour,maida, with vada pav and samosas being two of the most common go to buys. Both of these are pretty inexpensive, calorie packed, and everywhere, but they tend to be low on dietary fibre and they lean a lot on rapidly digestible refined carbs. In this piece we look at whether some portion of maida can be swapped for jowar, sorghum, which is an indigenous cereal grain, when people make these snacks. Using Indian food composition data, Indian food science work, Indian government agri and consumption statistics, and findings from national health surveys, the review checks sorghum nutrient profile, how it behaves in fried dough systems, and why it matters for India growing load of diabetes and obesity. It also talks through the practical headaches, like texture changes, lack of gluten, and the way oil uptake behaves during frying, plus what blend ratios might work best. Economic and cultural obstacles for street vendors are part of the story too, because adoption isnt straightforward. The article ends with the view that partial substitution, not a full swap of refined flour, is the more workable route for reforming street food in India.

Keywords: sorghum, vada pav, street food nutrition, jowar, samosa, refined flour

I. Introduction

Street food stalls selling vada pav and samosas are like a very visible little thing in city life across most Indian cities, they run almost like an informal economic, and cultural system, built on speed, lower cost, and of course taste. If you look at the consumer expenditure numbers gathered by the National Sample Survey Office (NSSO, 2014), food eaten outside the home is showing up as a real and increasing share of what households spend on food, especially in urban areas. And within that, cereal based snack items, show up among the most commonly bought categories (National Sample Survey Office [NSSO], 2014). In other words, a regular plate of samosas often costs less than a bus ticket in most Indian cities, and that kind of affordability is basically the reason hundreds of millions of people end up eating these foods on a frequent basis.

But here's the thing, vada pav and samosas depend almost completely on refined wheat flour for the outer shell, or the bread like part. Refining takes away the bran and germ layers of the wheat, which otherwise would bring dietary fibre, key micronutrients, and starch that digests more slowly. What is left, ends up behaving sort of like a simple sugar when it comes to digestion.

This issue really carries particular weight in the Indian context. The ICMR-INDIAB study, run by the Indian Council of Medical Research and among the larger nationally representative surveys on metabolic disease in India, showed that generalized obesity prevalence sat somewhere between 11.8% and 31.3% across states like Tamil Nadu, Maharashtra, Jharkhand, and Chandigarh, depending on what area was surveyed (Pradeepa et al., 2015). Around that same time, the same research team also mapped diabetes and prediabetes prevalence across fifteen states , and in general urban populations seemed to carry a heavier metabolic burden compared with rural populations (Anjana et al., 2017). The ICMR-INDIAB program likewise documented higher hypertension prevalence in both urban and rural India (Bhansali et al., 2015). Now, food habits are just one of several contributing drivers, and street food alone, you know, cannot fully explain these patterns. Still, considering how widely refined- carbohydrate based snacks are eaten, it feels fair to ask whether a focused ingredient swap could actually nudge population level nutrient intake in a noticeable way.

Sorghum could be one such substitution candidate. It is not at all an unknown or hard-to-find grain; farmers in Maharashtra, Karnataka, and Telangana have grown it for ages, mainly for rotis and bhakris, even if it has faded somewhat from the spotlight as wheat and rice consumption expanded across the country. This review suggests that bringing jowar back into two of the most commonly

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consumed street snacks could turn out as a small, but still meaningful, public health maneuver.

II. Methodology

This paper takes a narrative literature review vibe, not really a systematic review, and not an original experimental design either. The materials came from Indian institutions, from research that was run in India, and from Indian government publications, all of them dated in or before 2020. The goal was to pull together what is already known in India about sorghum's nutritional makeup, how sorghum behaves when used in fried dough type items, and also India's metabolic disease load, so that the feasibility of partial sorghum substitution in vada pav and samosas could be judged.

The sources were gathered into five, not super neat categories:
(1) national food composition resources, mainly the Indian Food Composition Tables from ICMR-NIN (Indian Council of Medical Research, National Institute of Nutrition), 2017;
(2) big, long epidemiological investigations on obesity, diabetes, and hypertension across India, especially those in the ICMR-INDIAB series (Pradeepa et al., 2015; Anjana et al., 2017; Bhansali et al., 2015);
(3) food science studies done at Indian centers, including the ICAR–Indian Institute of Millets Research work on sorghum antioxidant properties (Hariprasanna et al., 2015) and the Central Food Technological Research Institute CFTRI Mysore research on fried composite-flour snacks (Senthil et al., 2002; Ahamed et al., 1997);
(4) Government of India policy, regulatory, and statistical documents—such as Ministry of Agriculture production data, National Sample Survey Office consumer expenditure figures, Ministry of Housing and Urban Poverty Alleviation Street vendor numbers, and Food Safety and Standards Authority of India regulations (FSSAI, 2006, 2011);
(5) dietary reference benchmarks that were published by ICMR-NIN (2011).
The nutrient comparisons shown in Table 1 are mostly calculated estimates, pulled together by proportionally weighting published per 100 g composition figures for refined wheat flour and whole jowar flour. These values come from the ICMR-NIN Indian Food Composition Tables, used with a 70:30 blend ratio, so it's kind of a weighted mash of what's already reported not a direct readout. In other words, these numbers are illustrative projections based on secondary compositional data, not measured values from a physically prepared, or lab-tested, sample. Also, no primary sensory evaluation, no chemical analysis, and no consumer trial was carried out alongside this article. The sensory acceptability discussion in Section 5 leans on general principles reported in Indian composite-flour frying work (Senthil et al., 2002; Ahamed et al., 1997), rather than from a specifically graded sorghum-substitution sensory experiment.

III. Sorghum: Composition and Relevance to Public Health

3.1 Nutritional Composition of Jowar

According to the Indian Council of Medical Research's Indian Food Composition Tables, jowar has about 10.4 grams of protein and 6.3 grams of dietary fibre per 100 grams of raw grain, alongside roughly 4.1 milligrams of iron and 25 milligrams of calcium (ICMR-NIN, 2017). These numbers are pretty near, and in the case of fibre and iron, they actually go beyond the general adult dietary reference values for these nutrients laid out in India's national dietary allowance guidelines (ICMR-NIN, 2011). If you line this up against refined wheat flour, which sheds most of its bran-linked fibre, and also loses a sizeable share of micronutrients during milling, the distance between them is kind of big. Fibre matters not just for digestion, but also for glycaemic response: it slows gastric emptying, so sugars that come out from the outer layer of a fried snack reach the bloodstream more gradually when sorghum is used instead of a chunk of the usual flour.

Then there's also the research by the ICAR-Indian Institute of Millets Research, they looked at anti nutritional factors and antioxidant capacity in selected Indian sorghum genotypes, and reported genotype dependent antioxidant activity that links back to phenolic compound presence (Hariprasanna et al., 2015). So, alongside the fibre and mineral profile, jowar that's grown and studied in India seems to include a phytochemical set that you do not really get with refined wheat flour. This does not mean fried things turn automatically "healthy", because deep frying stays deep frying no matter what flour is inside the batter. Still, a shell made with extra fibre, minerals, and phenolic compounds is meaningfully different from one made mainly with refined maida.

3.2 National Production Context

Sorghum is a pretty established crop in India, not like some marginal or newly introduced thing. Based on Government of India, Ministry of Agriculture data, Maharashtra and Karnataka together make up most of India's sorghum (jowar)

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output, and then Madhya Pradesh, Tamil Nadu, Rajasthan, and Andhra Pradesh supply a big chunk of what's left (Government of India, Ministry of Agriculture & Farmers Welfare, Directorate of Economics & Statistics). It tends to do well under semi-arid conditions where wheat and rice kind of struggle, so that's one reason it stayed embedded in Deccan Plateau cropping patterns even after national food policy shifted heavily toward rice and wheat following the Green Revolution. That agronomic toughness is kind of a separate rationale from its nutritional profile, but it still supports the larger point that bringing jowar back into urban Indian diets does not really mean new agricultural investment. Instead, it needs revived city consumer demand for a crop that Indian farmers already grow at scale.

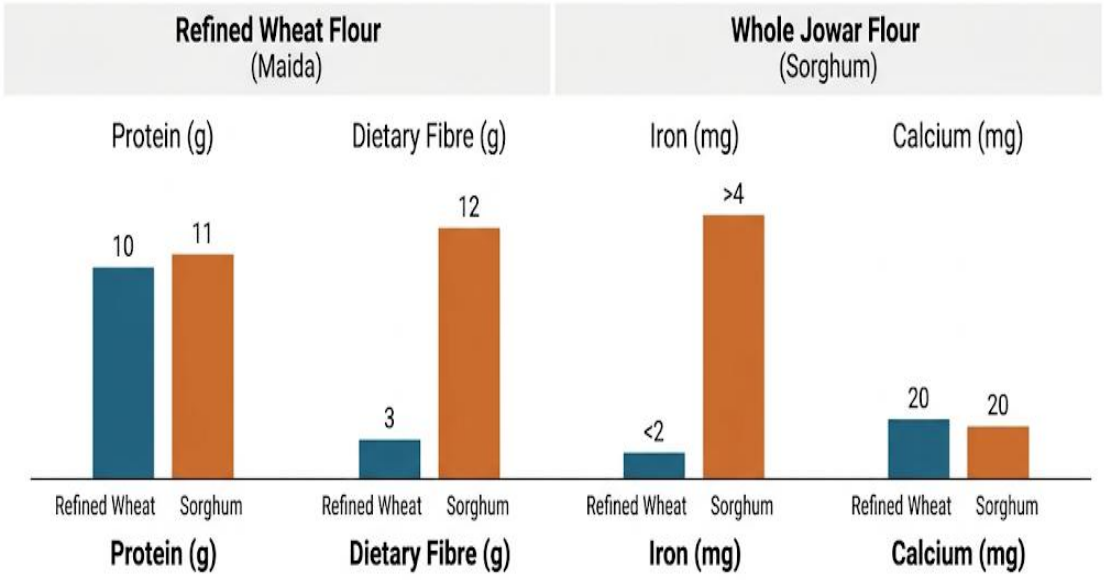
IV. Refined Flour, Fried Snacks, and Metabolic Risk

4.1 Concerns Associated with Refined Flour

Refined flour isn't really intrinsically harmful, but it is nutritionally sort of limited and it digests quite rapidly. If you pair it with deep frying — which is a cooking approach that meaningfully raises the fat level in the finished snack — then what you get is food that tends to be calorie heavy but nutritionally thin, like almost surface level goodness. Research done at the Central Food Technological Research Institute (Mysore) on deep-fried snacks made from wheat flour blended with other flours showed that the oil content in the fried product lands somewhere around 33 to 40 percent of the total product weight, with variation depending on the blend setup and the frying conditions (Senthil et al., 2002). That number feels even more significant once you look at the sheer amount of samosas or vada pav sold every day by individual street vendors, and also when compared with the National Sample Survey Office figures suggesting that eating outside the home makes up a notable and increasing portion of urban household food spending (NSSO, 2014).

National ICMR-INDIAB data also point toward a rising metabolic-risk pathway, and it lines up with more refined carbohydrate eating habits. The wider evidence base, which looks at obesity numbers (Pradeepa et al., 2015), diabetes plus prediabetes spread (Anjana et al., 2017), as well as hypertension prevalence (Bhansali et al., 2015) across several Indian states, really does not manage to pin one lone food item as the cause, not exactly. In other words no single food, even samosas or vada pav, can be reliably claimed to directly trigger diabetes or obesity by itself. Still, taken together, these findings back the bigger idea that in India the urban population is accumulating a heavier cardiometabolic load, and the way diets are put together, seems like a key contributing element, especially when refined carbohydrates are common.
As shown in Figure 1, the nutrient gap between refined wheat flour and whole sorghum flour is substantial rather than marginal, and this gap, multiplied across millions of daily servings, could plausibly matter at a population level.

Figure 1: *Nutrient Comparison Between Refined Wheat Flour and Whole Jowar Flour*



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This comparison kind of highlights protein, dietary fibre, iron, and calcium content across the two flour types, not really in a vague way but still. Jowar seems to have a clear advantage with fibre and iron content compared to refined wheat flour, while the protein levels are broadl y about the same between both. The key takeaway is that even if you do a partial substitution of maida with sorghum flour in a fried snack dough, you can still meaningfully increase the fibre and mineral content of the final product, without changing the way it's prepared.

4.2 Effects of Flour Blending on Fried Dough

Indian food science research on blended-flour fried snacks gives a kind of useful, but indirect, footing for thinking through how sorghum substitution might work in actual practice. CFTRI work on wheat flour mixed with soya flour for deep-fried snacks showed that the composite flours take up water in a different way than pure wheat flour does, and that in turn changes frying behavior, the amount of oil taken in, and the eventual texture (Senthil et al., 2002). In a similar line, Indian studies on deep-fried snack products made from blends of soya flour with corn, amaranth, and chenopodium starches reported that the structural and textural features move fairly clearly as the share of the non-wheat component increases (Ahamed et al., 1997). Even if these papers did not use sorghum directly, they both suggest a steady basic rule that matters for jowar, or sorghum, substitution: when a non-wheat flour portion grows inside the blend, water absorption capacity and dough, handling behaviors shift, and usually the frying conditions need re-tuning, to make the outcome match what you expect.

The lack of gluten in sorghum flour is basically the main technical constraint, for any recipe tweak of this kind. Gluten gives wheat dough a kind of elasticity and a gas-retention ability, and that s what drives the flaky feel in a samosa shell, plus the soft tenderness people expect from vada pav bread. Sorghum flour brings none of that elastic protein web, so a bun made only from sorghum is pretty unlikely to rise the same way a wheat bun does. If you look at the water-absorption outcomes and the structure notes from those Indian composite-flour frying studies (Senthil et al., 2002; Ahamed et al., 1997), a sensible swap level, somewhere around 20 to 40 percent sorghum, seems far more plausible than pushing to very high substitution amounts. That approach should help dough handling stay workable, but still provide a real nutritional improvement.

V. Applying Sorghum Substitution to Vada Pav and Samosas

5.1 Vada Pav: The Bread Component

Vada pav has two parts that are kinda flour-ish : the pav itself, a soft white bread roll, and the batter that coats the potato vada. That coating is usually made from besan, which is chickpea flour, not wheat. So that batter is already relatively nutritious, because besan brings its own protein plus fibre. Because of that, the main chance to reformulate is really the pav, like the bread. Now, if you want a tender bread roll, you need gluten to keep the structure, and to hold onto that softness, so total wheat replacement is kind of not realistic. You would need functional add-ins, for example vital wheat gluten. Using what's been shown in Indian composite-flour frying studies about water absorption and structural behavior, a 25 to 30 percent sorghum swap seems more likely to keep the structure intact, compared to pushing the substitution higher, and it should still boost fibre in the roll. The final bread would probably end up a bit denser, with a faint nutty flavor note. Honestly, that change might pair well with, not ruin, the spice-forward vada filling.

5.2 Samosas: The Pastry Shell

Samosas bring a whole other set of constraints. Their shell does not really need leavening; it just has to be firm enough to hold a filling and still come out crisp enough after frying that it shatters pleasantly when you bite it. In other words, samosas feel like a better candidate for sorghum substitution compared to vada pav bread, because skipping the leavening requirement removes a big technical hurdle. Indian work on fried composite flour snacks has suggested that blended doughs can be rolled and fried well even when the share of non wheat flour keeps rising, though you may need to tweak frying time and temperature. The reason is that composite flours absorb water in their own way, compared to wheat flour alone, (Senthil et al., 2002).So a samosa shell made with 30 to 40 percent jowar flour is a pretty defensible technical target and it should give a measurably higher fibre content per serving.

Table 1 presents a comparison of estimated nutrient contributions from a standard maida-based samosa shell against a 30% jowar-substituted version, based on compositional differences documented in the Indian Food Composition Tables.

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Table 1*Estimated Nutrient Contribution of Samosa Shell: 100% Refined Flour vs. 30% Jowar-Substituted Flour (per 100 g dry flour basis)*

Nutrient	100% Refined Wheat Flour	70:30 Wheat:Jowar Blend
Protein (g)	~10.5	~10.6
Dietary Fibre (g)	~2.7	~4.6
Iron (mg)	~2.7	~3.1
Calcium (mg)	~20	~21.5

Note. Values are calculated projections derived from ICMR-NIN (2017) composition tables at a 70:30 weighted blend ratio, not empirically measured values from prepared or tested samples.

The fibre increase shown in Table 1 is, sort of, the most notable finding. You see an increase from about 2.7 grams up to 4.6 grams of fibre per 100 grams of flour, and if we extrapolate that change across the total volume of samosas sold daily across Indian cities, it would mean a meaningful shift in overall fibre intake among street food consumers. For these people, the snacks often represent a substantial share of daily caloric intake, more as a regular staple than just an occasional indulgence.

VI. Economic and Cultural Barriers to Adoption

These considerations do not really happen in isolation. Street food vendors in India work on tight margins, and the whole street vending economy is pretty huge in terms of scale. Government of India policy documents (2009) estimated that around 2.5% of India's urban population was involved in street vending as a main livelihood (Government of India, Ministry of Housing and Urban Poverty Alleviation, 2009)—this is a workforce where even small jumps in ingredient cost can matter a lot. Jowar flour has, over time, often been listed at a higher price per kilogram than refined wheat flour across many Indian retail markets, partly because production volumes are smaller than wheat, and also because the supply chain is less consolidated. So, when you ask vendors with thin margins to swallow higher ingredient expenses, but there is no clear signal that customers will actually pay a premium for a "healthier" product, it creates a real adoption problem.

There is also a cultural dimension specific to the Indian street food context, consumers dont pick vada pav for nutritional optimization, they pick it for its familiarity. Like, its tied to home, college years, or even a particular neighborhood stall where you go without thinking. If you change the texture or flavor profile of something that has this much emotional and cultural attachment, you risk alienating the same people who the change is supposed to help. So any rollout would probably need to move slowly, maybe starting with more health minded urban outlets, or packaged frozen retail versions within India, rather than doing uniform mandates across every roadside vendor. Any formal reformulation or labeling, or vendor-directed initiative, would also have to stay inside the regulatory framework built under the Food Safety and Standards Act, 2006, and the associated sales regulations (FSSAI, 2006, 2011).

Since no dedicated Indian sensory study on graded sorghum substitution in fried street snacks was found, the argument for a moderate blending approach here leans on the broader pattern seen in Indian composite-flour frying research. Basically, structural and handling properties tend to change in a progressive way as non-wheat flour content goes up (Senthil et al., 2002; Ahamed et al., 1997), instead of relying on a directly measured consumer acceptance curve that is specific to sorghum-substituted vada pav or samosas.

VII. Limitations

This review has a few limitations that really need to be kept in mind before its conclusions are treated like absolute truth. For instance, no original laboratory work or sensory tests were done on sorghum substituted vada pav or samosas. So the numbers in Table 1 for nutrients are not empirically measured, they are calculated projections that come from published composition data. In other words ,they would still need hands on food testing before being quoted as definitive.

Also, a dedicated graded substitution sensory study for sorghum wheat composite biscuits, bread, or fried snacks done within India wasn't found. Because of that, the substitution level guidance in Sections 4 and 5 is basically reasoned extrapolation from related Indian composite flour frying research. It is not direct empirical evidence for sorghum specifically. Then there's the economic part, which leans heavily on just one older policy estimate for street vending prevalence (Government of India, 2009). Plus it uses broad market observations about jowar pricing. That's a weaker

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basis than current product specific cost figures that compare sorghum blended and refined flour ingredient costs at the actual vendor scale. Finally, this reads like a narrative review rather than a systematic review. Source selection wasn't guided by a pre-registered search plan, so the process is less reproducible than it could be.

VIII. Conclusion

Vada pav and samosas are not really going to vanish from Indian street food culture; they are so affordable, so rich in taste, and also so knitted into daily life, that people won't let them be regulated out or reformulated out of existence. That said, the flour used for these snacks is not something that has to stay the same by force. Sorghum, which is already grown widely in Maharashtra, Karnataka, and nearby regions, brings measurable nutritional upgrades— more fibre, extra iron, and phenolic compounds you don't get from refined wheat flour— while still letting consumers keep the snack they already want. The technical parts about texture and dough behavior are probably doable, if the substitution level stays moderate, because there's related Indian research on composite flours for frying. Still, this exact point really should be validated with direct sorghum-focused trials carried out in India. What's missing here isn't scientific reasoning, it's rather economic push, cultural momentum, and enough India specific taste and sensory work to make the swap actually worth it for vendors and for regular buyers too. Getting there will likely need patience, some price support aimed at the right stage, and repeated recipe tweaking grounded in Indian lab and field testing. Even so, the basic evidence does point toward pursuing this as a feasible path for healthier street food, not just a distant idea.

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