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Short Communication

Amylase-treated Sudanese Cereal-based Foods: A Low-cost Strategy to Boost Energy Intake in Young Children

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Abstract

Malnutrition remains a persistent issue in Sudan, affecting millions of people, primarily children under five years old. The Integrated Food Security Phase Classification (IPC) alert for Sudan highlights the urgent need for multi-sectoral humanitarian assistance to save lives, prevent worsening acute malnutrition, and avert potential deaths, particularly among children. Many Sudanese children are already malnourished due to being weaned on cereal-based traditional meals. These diets are thick, highly viscous, and low in nutrient density for young children. Therefore, an immediate evaluation (e.g., of traditional complementary foods) and action (e.g., improving nutritional practices among healthcare providers and increasing public awareness) are necessary to address the high levels of acute malnutrition and prevent loss of life. This short communication outlines a practical method to produce ARP and its incorporation into common cereal-based foods; this approach may help reduce viscosity and increase energy density in complementary feeding. This study presents a compelling case for using amylase-treated cereal-based foods to fight malnutrition in Sudan. It combines scientific insight with practical application, making it an invaluable resource for both researchers and policymakers. Future research into the implementation challenges and long-term effects of ARF consumption is recommended.

Keywords: amylase-rich food, malnutrition, traditional cereal foods, Sudan

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1. Introduction

The Integrated Food Security Phase Classification (IPC) analysis for Sudan, published in December 2024, predicted that 24.6 million people would face acute food insecurity (IPC Phase 3 or higher) through May 2025, with famine (IPC Phase 5) persisting or projected in 10 locations. The alarming levels of acute malnutrition observed throughout the harvest and post-harvest periods align with IPC Acute Malnutrition Phase 4 (Critical). This deteriorating situation continues to pose a significant and increasing threat to people's lives, especially children [1].

The challenge with malnutrition is that only a small percentage of cases (severe cases) are reported to healthcare providers, while the rest (mild to moderate cases) stay hidden in the community and are likely to worsen if not treated [2]. Therefore, it is essential to identify these cases early and provide appropriate treatment to prevent their progression [2].

Sudanese households mainly depend on traditional diets that include cereal grains such as wheat, maize, sorghum, and millet. These grains contain tannins, which are gastroprotective, anticarcinogenic, and antiulcerogenic and have cholesterol-lowering properties [3]. Furthermore, they include phenolic compounds such as flavonoids and phenolic acids, which contribute to the color, oxidative stability, flavor, taste, and texture of the food, while also exhibiting antimicrobial, anticarcinogenic, and anti-inflammatory activities [4–9]. Cereals, on the other hand, contain phytic acid and enzyme inhibitors, which limit the amount of nutrients they hold, especially for children [10, 11]. Weaning younger children (aged six months and older) on traditional cereal-based foods is a common complementary feeding practice among Sudanese households due to its availability and affordability. However, these foods are considered low in nutrient density and calories, tend to be highly viscous, and lack sufficient micronutrients for children. Some potential strategies to increase caloric intake from traditional diets include using breast milk, vegetables, and animal proteins wisely, adding more active ingredients, fermenting food, and allowing cereals to germinate to release amylase [2, 12].

In this short communication, we offer a simple and affordable method for processing and combining amylase-rich powder (ARP) made from wheat or other grains with regular family meals. This method produces thin, less viscous foods that help enrich young children's diets with calories (Figure **1**).

2. Common Sudanese Traditional Foods

Most cereal-based foods in Sudan are consumed as fermented dough (*Ajin*) products, primarily in the form of stiff gruels (*Asida/Aceda*), bread sheets (*Kisra*), and thin porridge (*Nasha*), made from sorghum or millet. They also include thin or semi-solid porridge (*Medida*), bread sheets (*Gorassa* and *Fatteer*), doughnuts (*Zallabia*), and breads (*Aish*), which are made from wheat (Figure **2**) [13]. During cooking, cereal flour starch gelatinizes, creating a thick and viscous porridge, which can result in insufficient protein and energy intake [14]. Traditionally, the nutritional value of these foods has been improved by the addition of skim milk, sour milk, fenugreek (*Hilba*), legumes, cooked dry meat (*Shermout*), okra powder (*Weika*), cooked dry and fermented fish (*Fasikh* and *Moloha*), fermented leaves and fats (*Kawal* and *Mires*), and spices such as cardamom, cinnamon, ginger, and black pepper, as well as through cereal germination and fermentation [14, 15].

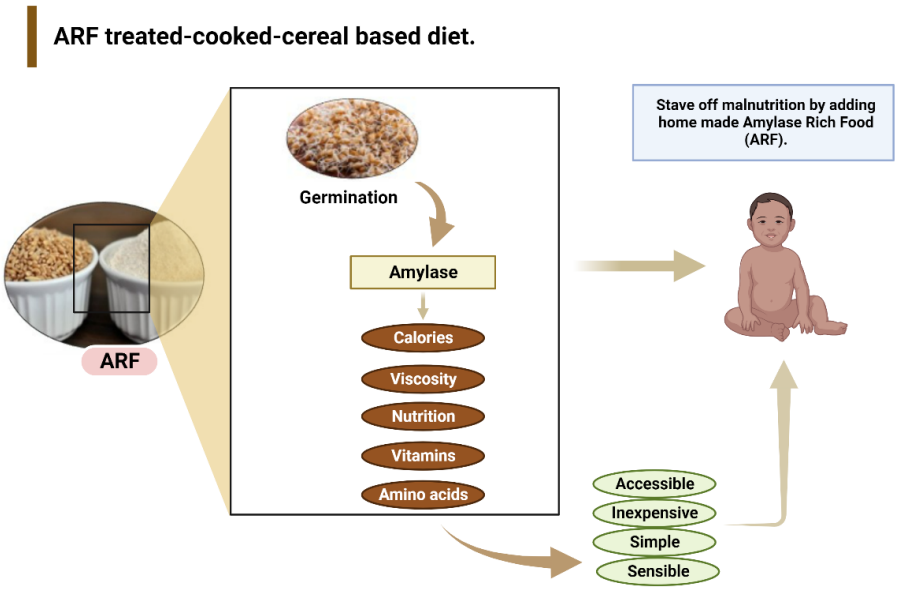

Figure 1: Benefits of amylase-treated food (created with BioRender.com [license number AC26AH896M]).

Figure 2: Common traditional Sudanese foods (created with BioRender.com [license number TH26AH8TI1]).

3. Amylase-rich Cereal-based Food

3.1. Advantages of cereal germination

A popular and proven method for improving grain nutrition is germination. Germination affects the physical characteristics, nutritional content, and biochemical activity of foods. Foods that have been germinated generally show higher levels of vitamin C, riboflavin, niacin, lysine, and tocopherols, as well as thiamine with extended germination [16]. Additionally, germination has long been used to reduce antinutritional factors and soften the

kernel structure [17]. The amylases in malted flour hydrolyse starch into sugars when heated water or milk is added. This creates a slurry that is low in bulk, rich in nutrients, and has a pleasant taste, making it suitable as a weaning food for young children [18].

3.2. Amylase

Starch (a long-chain carbohydrate) in grains is hydrolyzed by amylase into dextrins, oligosaccharides, and glucose [19]. Saranraj and Stella classified amylase into alpha, beta, and gamma amylase [20]. Like other carbohydrases, amylase is essential as a processing aid in the food and beverage industries. It is widely used in the feed, textile, and pharmaceutical sectors, as well as in the production of various sugar syrups, prebiotics, and methods to reduce lactose content in milk [21, 22]. Traditionally, germinated cereal flour has been a major source of amylase (known in Sudanese tradition as Zereaa). However, in recent years, researchers have shown increased interest in utilizing microbes to produce amylases through solid-state and submerged fermentation techniques [23, 24]. The best substrates for solid-state fermentation to produce amylase are cereal food waste and leftovers, especially millet and wheat bran [25–27].

3.3. ARF preparation process

The preparation process began with the sanitation and soaking of cereals. A suitable cereal type was selected, washed, and any visible dirt was removed. Then, sufficient water was added, and the cereals were covered and left to sit for up to 12 hrs. The excess water from the cereals was then drained, and they were covered with a clean, damp cloth before being placed in a cool, dark room for proper germination. The cloth was spritzed with water every 6 to 8 hrs to keep it moist. Different cereals take varying amounts of time to germinate; wheat germinated the quickest and produced the highest amylase activity after 48 hrs. The germinated cereals were then exposed and dried in direct sunlight for 6 hrs or gently roasted in a cooking pot (*tawa*) over low heat. The drying process is critical because any remaining moisture could reduce amylase activity. The germinated grains were then sieved, and any cyanide-containing roots or shoots were removed bitterness and ensure uniform milling before milling the dried germinated cereals into ARP, either manually or electronically. To prevent any decline in amylase activity, the powder was stored in a moisture-proof container. If stored at room temperature, the active contents of ARP last for 4 to 6 weeks. After the gruel/porridge was fully cooked, 1–2 g ARP was added to 100–200 g of food and stirred thoroughly for at least 10 minutes. [2] (Figure **3**).

3.4. Examples of Practical applications of ARF in different settings

The addition of amylase-rich flour from germinated wheat to supplementary food for children in nine rural Community Nutrition Centers under the Bangladesh Integrated Nutrition Project (BINP) led to increased intake of supplementary food, weight gain, length, and weight-for-height after 6 weeks on the diets treated with amylase-rich flour [28]. Additionally, adding amylase to fortified blended foods improved energy and nutritional intake by 47–67% in Burkinabe children aged 12 to 35 months [29]. Furthermore, a study using exploratory qualitative research and participatory action research identified facilitators and barriers to using amylase-rich flour to enhance supplemental foods in the Kersa District community of Eastern Ethiopia [30].

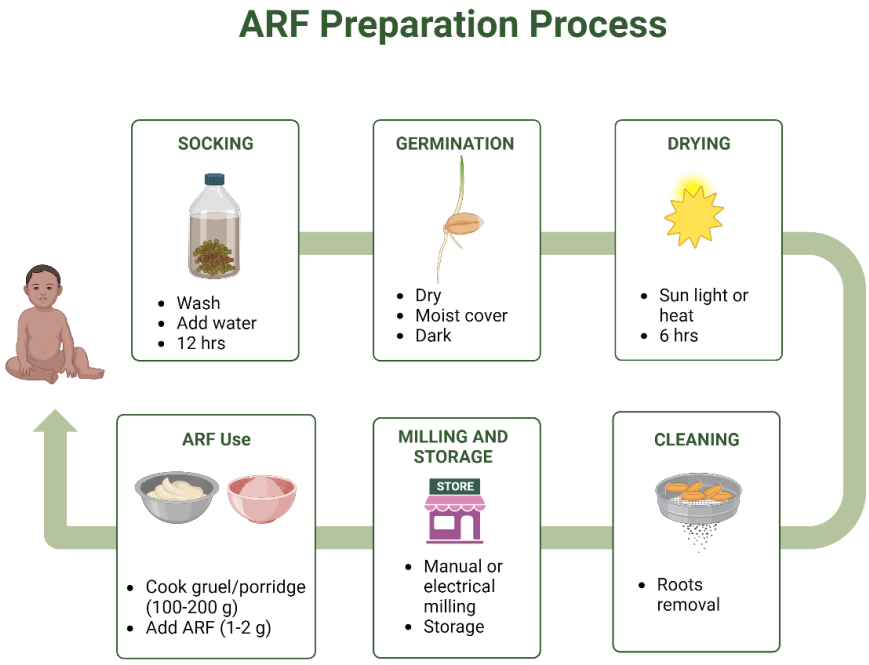

Figure 3: ARF generic preparation process (created with BioRender.com [license number WC26AH8Y6K]).

4. Conclusion

Facilitating the transition to family foods during the first 24 months of life has remained a challenge in Sudan and abroad. The use of Amylase-Rich Food is a practical and affordable strategy to improve complementary feeding practices. This study presents a compelling case for the use of amylase-treated cereal-based foods in addressing malnutrition in Sudan. It combines scientific insight with practical application, making it a valuable resource for both scholars and policymakers. Future research into the implementation challenges and long-term effects of ARF consumption is recommended.

Declarations

Acknowledgements

Not applicable.

Ethical Considerations

Not applicable.

Competing Interests

None.

Availability of Data and Materials

All data used are included within the study.

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Abbreviations and Symbols

ARF: Amylase-rich food

ARP: Amylase-rich powder

IPC: Integrated Food Security Phase Classification

BINP: Bangladesh Integrated Nutrition Project

AI Use Disclosure

The authors declare that no generative AI tools were used in the preparation of this manuscript.

Author Contributions

Concept, design, editing, and revision of the work: MAM, IAA, RB, RK; Drafting the work or reviewing it critically: MAM, IAA, RB, RK; Final approval: MAM, IAA, RB, RK; Accountability for all aspects of the work: MAM, IAA, RB, RK.

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