ABSTRACT

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The present study aimed at studying the conditions for the preparation of Amylase Rich Food (ARF) from cereals and millets and to test the feasibility of developing ARF from legumes; to establish the safety of ARFs with respect to hydrocyanic acid content and that of gruels with respect to the microbial load and the effect of heat treatment on the above; to study the effect of addition of salt, oil and jaggery on the viscosity of gruels and reduction in viscosity on addition of ARF using various substrates; and finally to study the effect of addition of ARF on in vitro starch digestibility of various gruels if any.

A steeping period of 6 hours for pearlmillet and that of 12 hours for wheat, corn and sorghum was required for maximum germinative activity (92 - 97%). A germination period of 24 hours was required for sorghum, corn and pearlmillet and that of 48 hours for wheat in order to obtain an ARF with optimum amylolytic power under ambient conditions of preparation. The germinated grains were dried at 50°C and milled to a flour of +60 BSS particle size. The legumes studied namely, green gram, bengal gram and soya bean were found to be unsuitable for the preparation of ARF due to their poor amylolytic activity even at the end of 96 hours of germination.

The ARF prepared from wheat, corn, pearlmillet and sorghum using standardised conditions was required at 4% solid contents level for desirable viscosity reduction. The ARF from sorghum had highest viscosity reduction power (98%) followed by pearlmillet (96%), corn (86%) and wheat (72%). All the ARFs when incorporated at 4% of total solids in gruels held at 50°C, 60°C,

70°C and 80°C, showed negligible viscosity reduction at 50°C and peak liquifying activity at 80°C.

Preliminary screening indicated the presence of HCN in ARF prepared from sorghum. Detailed investigations using three cultivars of sorghum namely, GJ35 (red variety), GJ36 and market variety (white variety) revealed the presence of HCN in negligible amounts in the ungerminated seed (10 - 28 ppm) which increased with progressive germination. GJ35 variety had the highest HCN content at the end of 120 hours of germination (608 ppm) followed by GJ36 variety (383 ppm) and the market variety (179 ppm). The rate of elaboration of HCN was rapid during first 24 hours in the GJ36 and market variety while it peaked at 72 hours in the GJ35 variety of sorghum. The HCN content decreased on germinating the grains beyond 24 hours in case of GJ36 and market variety and 72 hours in case of GJ35 variety. About 77% - 85% of the total HCN was concentrated in the vegetative portion which formed 2 - 7% by weight of the ungerminated grain. The HCN content of the ARF from devegetated grain was well within the stipulated limit of 200 ppm. Heat treatment at 70°C and above was found to reduce the HCN content substantially (40 - 50 times) and render the ARF safe for consumption.

Studies on microbial quality of raw ingredients used for gruel preparation and ARF indicated a high total count, *E. coli* count and the yeast and mould count. The total count and yeast and mould count of the wheat flour and the ARF was similar. Water was the main source of *E. coli* while jaggery contributed chiefly to the yeast and mould count. Keeping in mind the ratio in which the ingredients are utilised for making the gruel, the microbial load contributed by each in the decreasing order is as follows: water,

wheat flour, jaggery and ARF. The raw gruels had a considerably high total viable count (35 - 48 cfu X 10^3/g of food), *E. coli* count (12 - 17 cfu X 10^3/g of food) and yeast and mould count (2 - 5 cfu X 10^3/g of food). Addition of ARF stored for 0-6 months did not alter the same. Cooking destroyed all the vegetative cells and the cooked gruels with or without ARF could be stored safely for a period of 3 hours under ambient conditions. Beyond a storage period of 3 hours the total count was found to exceed the IS limit of 50000 microorganisms/g of food. The *E. coli* and yeast and mould too regenerated at the end of this period.

Studies on effect of various ingredients utilised for the preparation of gruels on the viscosity indicated that, while incorporation of pulse flours and salt yielded a gruel with higher viscosity (+0.6% to +80%), addition of jaggery and oil lowered the paste viscosity (-13% to -93%). A 25% - 30% solid content gruel could be prepared from cereals namely wheat, corn, sorghum and pearlmillet in combination with pulse flour from bengal gram and green gram (3:1 ratio) with added jaggery and oil. On substituting jaggery with salt, the solid contents could not be increased beyond 20%. The gruels prepared using jaggery and oil had a higher energy density than those with salt and oil or neither (2.22 Kcal/g, 0.86 Kcal/g and 0.86 Kcal/g respectively). A similar percentage reduction in viscosity was achieved on incorporation of pearlmillet ARF at 4% of total solid level (86% - 97%) in all the cereal/ cereal+pulse gruels with oil+jaggery/ oil+salt. Pearlmillet ARF at 4% of total solids could effectively lower the viscosity of 25% solid content gruels from Corn Soya Milk, Corn Soya Blend and Energy Food when added either prior to cooking to the dry mix or when added during cooking. The pearlmillet

ARF incorporated at 4% solids level in the four brands of commercial baby foods studied yielded a low viscosity product on reconstitutuion with boiling water. This in turn facilitated raising the solid contents per feed and the energy density by 1.5 - 2 times.

The in vitro starch digestibility of raw gruels was lowest in corn (20%) followed by sorghum (42%), wheat (50%) and pearlmillet (63%). The starch digestibility in vitro was further lowered on incorporation of flour from green gram and bengal gram (4% - 5%). Cooking improved the digestibility by 30% - 50%. Corn Soya Milk, Corn Soya Blend and Energy Food had a better starch digestibilty in the raw state as well as the cooked state (70% vs 80%). The improvement in starch digestibility was significant on incorporation of ARF (12 - 20%) and all the gruels with ARF had similar in vitro starch digestibility.