STANDARDIZATION OF FERMENTATION TIME FOR FOXTAIL MILLET TO BLACKGRAM

Abstract: Fermentation is a household procedure used to preserve and produce diversified products enriched with bioactive components. Different combinations of instant or ready to use dosa mixes were prepared using foxtail millet, rice and pulses like black gram and green gram dals by fermenting at 37°C for 6, 12 and 18 hours depending upon the pulse used. The results revealed that 12 hours of fermentation was necessary to give best dosa for all combinations similar to control. The combination of 70% foxtail millet, 20% black gram and 10% green gram gave better results when compared with control and the percentage increase in appearance, texture, flavour and overall acceptance were 3.66%, 2.41%, 1.18% and 1.19% respectively with decrease in taste by 7.53% and no change in sourness for both samples.

Keywords: Foxtail millet, green gram, black gram, fermentation, instant foods, instant dosa, sensory evaluation.

Introduction: Convenience foods are commercially prepared for the ease of consumption and can also be preserved for a longer duration of time suitable today's busy lives. These types of foods first emerged from the United States after World war Ⅱ (Gosse *et al*., 2008). In the beginning, they were designed for military to overcome problems of short storage and for ease of preparation in the battle grounds (Rudolph *et al*., 2012).

Foxtail millet (FM) [*Setaria italica* (L.) Beauv.] is a grain and forage crop that can grow in nutrient-poor soils under erratic weather conditions (Nadeem *et al*., 2018). Foxtail millet was part of balanced diet of the bygone times but has been replaced with other crops. In the current changing life style and food habits, consumption of nutrigrains in daily diet is reduced due to lack of cultivation of these cereals along with abundant availability of less nutritious cereals at lowered cost (Thippeswamy *et al.*, 2017).

Foxtail millet is a native of China and was domesticated in the highlands of Central Asia (Amgai *et al*., 2011). It can be grown in semi-arid regions (Hancock seed co, 2014). In more recent years foxtail millet is distributed in all most all parts of China, some parts of India, USA, Canada, the Korean Peninsula, Japan, Indonesia, Australia and northern part of Africa (Li and Brutnell, 2011).

Like most of the millet varieties, foxtail millet continues to exist as an underutilized food. However, in the recent times, it is receiving increased research and commercial attention, because its cultivation is not too demanding from agricultural point of view as it

incurs less agricultural inputs and has ability to grow in different terrains with limited water supply (Sharma and Niranjan, 2017). The research has shown that foxtail millet has a stress resistant gene with stress tolerance properties (Muthamilarasan and Prasad, 2015).

During the 1950's and early 1960, wheat and rice earned huge attention as staple food crops and all crop improvement techniques were directed towards these because of their ability to produce high yields along with combating food poverty and provide food security. This kind of focused treatments in the green revolution era on wheat and rice crippled the cultivation of millets which otherwise have sustained extreme conditions to yield high produce in dry lands as they have adequate nutritional composition that can restore the nutritional deficiencies and maintain good health (Yang *et al*., 2012).

Foxtail millet contains 14-16% of protein, 6-8% of crude fibre and is also a good source of iron, zinc and calcium (Muthamilarasan *et al*., 2016). Foxtail millet bran contains 8-10% of crude oil that is rich in linoleic and oleic acids with 66.5 and 13.0% respectively (Liang *et al*., 2010).

Foxtail millet is extensively used as an excellent source of energy for children, diabetics, sick people, pregnant and lactating women (Dwivedi *et al*., 2012). Consumption of foxtail millet by diabetics helps in maintaining low blood sugar levels, glycosylated haemoglobin and serum lipids, thus preventing heart diseases (Thathola *et al*., 2010).

A diet balanced with all the five food groups is essential for the overall wealth of an individual's health. Pulses and legumes are part of a healthy and nutritious diet. They are part of human diet for more than 10,000 years and are still most widely used foods in the world. They are a sound source of protein and fiber along with the considerable amounts of vitamins and minerals such as iron, zinc and magnesium (Vrinda *et al*., 2017).

Fermentation is a long standing food processing technique for improving the shelf life, flavor, texture and functional properties of food (Hutkins, 2018). Contemporarily, the utilization of fermented foods holding live microorganisms has risen as an important dietary principle for revamping the human health through gut microorganism (Marco *et al*., 2017).

Fermented foods and beverages are receiving increased attention due to their improved shelf lives, non- toxic nature, functional, sensory and nutritional properties. This processing technique increased the presence of bioactive compounds like vitamins, minerals and other constituents and enhanced the rate of absorption into the blood. They benefit the human body by preventing health problems like gastrointestinal disorders, diabetes and cardiovascular diseases (Rezac *et al*., 2018).

Fermentation is the traditional method of preserving food which helps in providing characteristic flavour and significantly improving the nutritional properties of a product. Fermenting millets helps in modifying the chemical composition that benefits human health by controlling and preventing many life styles diseases that are on the rise now a days (Ahmed *et al*., 2013).

Numerous food processing techniques such as milling, decortication, soaking, germination/malting and fermentation were developed to efficiently enhance nutritional and sensory properties of the millets, thus helping to fight hidden hunger among rural people (Rathore *et al*., 2016).

Studies on fermentation and product development of fermented foxtail millet are minimal. So, the present study was designed for profiling of fermentation parameters of foxtail millet in ready to use dosa mix.

Materials and methods:

Procurement of raw materials: The foxtail millet variety SiA 3085 was acquired from Department of Agronomy, Agriculture College, PJTSAU, Polasa, Jagtial and rest all the ingredients like rice, black gram, green gram, oil and salt were procured from the local markets of Hyderabad.

Fermentation of the grains: Fermentation was carried out at room temperature with foxtail millet, black gram, green gram and rice in three combinations as given belwo:

- Control: Foxtail millet - 70% and black gram - 30%
- Combination 1: Foxtail millet - 70%, black gram - 20% and green gram - 10%
- Combination 2: Foxtail millet - 50%, rice - 20% and black gram - 30%,
- Combination 3: Foxtail millet - 50%, rice - 20%, black gram - 20% and green gram - 10%)

Rice was completely substituted with foxtail millet in control and fermentation carried out at different intervals of 6, 12 and 18 hours. Depending on the pulse and rice combination, fermentation was done at 6, 12 and 18 hours or 6 and 12 hours.

Preparation of fermented instant dosa mixes: The fermented grains were dried in a tray drier at 50^{o}C until constant weight was recorded and ground to fine flours followed by sieving with a 0.5 mm sieve (Carciochi *et al*., 2016).

Reconstitution and preparation of dosa from the instant mixes: 50.0 g of the developed instant dosa mix at each incubation time was blended with 70.0 ml of water and kept aside for 20 minutes. Salt was added to taste, a scoop (50.0g) of dosa batter was poured on a heated

flat griddle, spread from inside out and roasted to golden brown (visual appearance) with flipping to the other side if required (Sushmitha *et al*., 2017).

Sensory evaluation: Standardization of rice to black gram dal dosa mix was done by sensory evaluation using 9-point sensory hedonic scale. A semi-trained panel of 15 members from PGRC, PJTSAU were selected. The panellists were provided with samples in plates coded with three-digit numbers and were asked to rinse their mouth with water after testing each sample. The instant dosa was evaluated for their appearance, sourness, texture, flavour and overall acceptability. The nine points in the hedonic scale ranged from 1 to 9, 1 being I dislike extremely *i.e.*, very bad and 9 being I like extremely *i.e.*, the product is excellent in that particular attribute (Meilgaard *et al*., 1999).

Results and discussion:

Dosa made with foxtail millet to black gram along with other combinations of foxtail millet, rice and pulses (black gram and green gram) were evaluated for sensory characteristics and presented in Figures 1 to 4. The sensory scores of control at 6, 12 and 18 hours of fermentation for appearance ranged from 7.2 to 8.2, sourness from 7.9 to 8.3, texture from 7.7 to 8.3, flavour with 7.5 to 8.5, taste with 7.5 to 8.3 and overall acceptance from 7.7 to 8.4 (Figure 1).

The sensory scores of first combination of same fermentation times for appearance ranged from 7.9 to 8.5, sourness with 7.4 to 8.3, texture with 7.9 to 8.5, flavour with 7.7 to 8.6, taste with 7.6 to 8.6 and overall acceptance with 7.6 to 8.5 (Figure 2). The sensory scores of second combination of 6 and 12 hours of fermentation were 7.7 and 8.3 for appearance, 7.6 and 8.1 for sourness, 7.9 and 8.2 for texture, 7.7 and 7.9 for flavour, 7.8 and 8.2 for taste, 7.5 and 8.2 for overall acceptance respectively (Figure 3). The sensory scores of third combination consisting of rice were done at 6 and 12 hours were 8.0 and 8.2 for appearance, 7.3 and 8.1 for sourness, 7.3 and 7.9 for texture, 7.8 and 8 for flavour, 7.7 and 8.3 for taste, 8 and 8.1 for overall acceptance respectively (Figure 4).

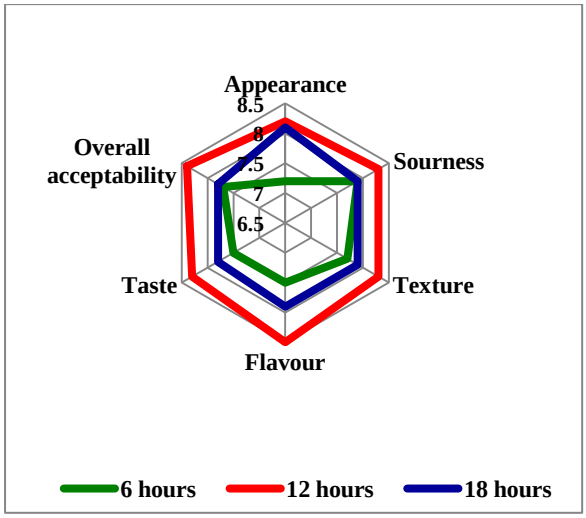

Figure 1: **Sensory aspects of control (foxtail millet to black gram)**

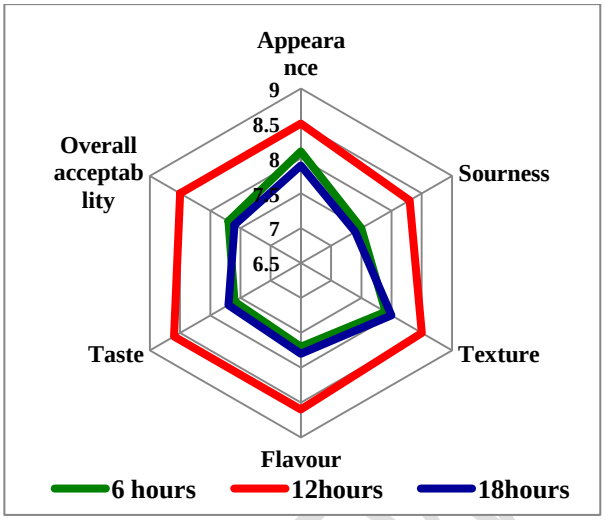

Figure 2: **Sensory aspects of combination 1 (foxtail millet to black gram and green gram)**

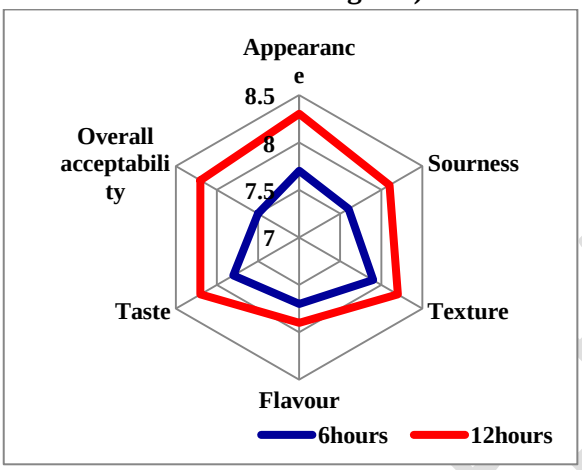

Figure 3: **Sensory aspects of combination 2 (foxtail millet to rice and black gram)**

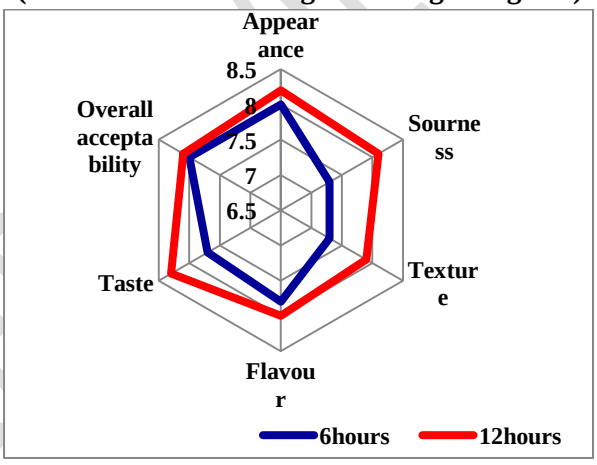

Figure 4: **Sensory aspects of combination 3 (foxtail millet to rice, black gram & green gram)**

The results revealed that of all the fermentation time periods and for all the combinations including control, dosa made with 12 hours of fermentation gave highest scores for all sensory attributes and was best accepted. When compared to the control, dosa made with combination 1 and combination 2 showed increase in appearance by 3.66% and 1.22% respectively, whereas combination 3 neither increased nor decreased. In terms of sourness, combination 1 and combination 3 showed similarity to control, whereas combination 2 showed decrease of 2.41%.

In terms of texture, combination 1 showed an increase in 2.41% when compared to control, whereas combination 2 and 3 showed decrease of 1.20 and 4.82% respectively. Flavour of the dosa made from first combination was liked more than control by 1.18%, whereas combination 2 and 3 showed decrease by 7.06 and 5.88%. The taste of the dosa made from three combinations showed decrease of 7.53, 11.83 and 10.75% respectively when

compared with control. In terms of overall acceptance combination 1 was liked by 1.19% whereas, combination 2 and 3 were not agreeable showing a decrease of 2.38 and 3.57% respectively (Figure 5).

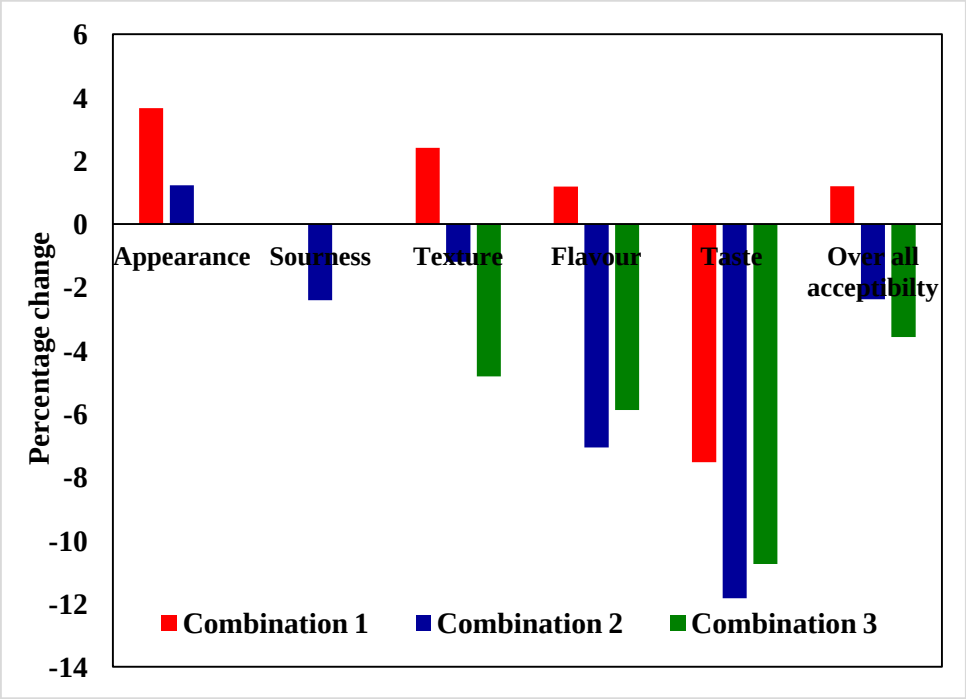

Figure 5: Percentage change in sensory aspects with control and combinations

Conclusion: The present study showed that 12 hours of fermentation resulted in best dosa among the selected time periods irrespective of the combinations chosen. When compared with control, combination 1 showed 3.66% increase in appearance, 2.41% in texture, 1.18% in flavour and 1.19% in overall acceptability, whereas taste decreased by 7.53% with no difference in sourness to control. Thus, combination 1 was liked after control, while the other two combinations were not accepted based on sensory evaluation results.

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