REVIEW ON GLUTEN FREE READY-TO-COOK KHEER MIX

Project Report

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CERTIFICATE

This is to certify that Kirti Nehra has personally completed M.Sc. Pre- dissertation entitled '**STUDY ON PREPARATION OF GLUTEN FREE READY-TO-COOK KHEER MIX'** under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of pre-dissertation has ever been submitted for any other purpose at any university.

The project report is appropriate for the submission and partial fulfilment of the conditions for the evaluation leading to the award of Master of Food Science and Technology.

Signature of Supervisior

Er. Jasleen Kaur Bhasin

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DECLARATION

I hereby declare that the work presented in the dissertation 1 entitled **'STUDY ON PREPARATION OF GLUTEN FREE READY-TO-COO KHEER MIX'** is my own original work. The work has been carried out by me at School of Agriculture, Lovely Professional University, Phagwara, Punjab, India under the guidance of **Er. Jasleen Kaur Bhasin**, Assistant Professor (Food Technology) of School of Agriculture, Lovely Professional University, Phagwara, Punjab, India for the award of the degree of Master of Science in Food Technology.

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I certify that the above statement made by the student is correct to the best of my knowledge and belief.

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CHAPTER 1

INTRODUCTION

The investigation was undertaken to develop a suitable formulation of kheer ready-mix using four main constituent including Barnyard millet, dates, soyamilk, alovera gel in different proportions. The kheer produced having desirable quality, colour, appearance, consistency, flavour, nutritional value and overall acceptability. Most of Indian population depend on millet as a coarse cereal, thus india is the largest producer of millet. The nutrient value of millet is comparably superior to other cereal food grains and it is used as a substitution for cereal for its higher nutritive value.

1.1.**BARNYARD MILLETS**

There are two species of barnyard millet which are readily used under the genus Echinochloa, are E.frumentacae (Indian barnyard millet) and Eesculenta (Japanese barnyard millet), for food and fodder which are mainly consumed by hilly and tribal communities specially of India, Japan and China. it is found mainly in marginal rainfed areas because of its short life cycle. The genus Echinochloa belongs to the tribe Panicae, subfamily (Clayton and Renvoize 2006). Barnyard millet is amongst the earliest domesticated millets, having more than 35 species.

In India, barnyard millet is the second important small millet after finger millet. In India it is mainly found in the region of Uttarakhand in the north and in Deccan plateu region of Tamil Nadu in the south. Wild barnyard millet is mainly found between the paddy feild as weed and are consumed in harsh situation like draught.

1.2. **GROWTH AND DEVELOPMENT**

Millets are a group of highly variable small-seeded grasses widely, grown around the world as a cereal crops or grains for fodder and human consumption. millet production is done in very little water it doesn't require irrigation, thus do not burden the state with

demands for irrigation or power.Barnyard millets is of the underutelised crop with high nutritional value. It is mainly grown as a forage grass in the USA and Japan. In China it is used as a substitute of rice when paddy fails. It is the fastest growing crop, which can be grown in just six weeks. The origin of barnyard millet is from eastern part of India. It is used to make different types of porridges. Many variety of kheer, and traditional foods are prepared from barnyard millets, it is mainly consider as a fast food i.e. food consume during fast periods.

1.2.1. **Origin and history**

(Chidda singh, Modern Techniques Of Raising Field Crop, 2014.)

Barnyard millet evidences are also found in the ancient literature of India. It has been cultivated in china for more than 2000 years. According to some of the investigators barnyard millet is originated in central Asia and spread to Europe.

1.2.2. **Area and distribution**

Barnyard millet is grown in India, China, Japan, Malaysia, East indies. In China and Japan when rice production fails it is grown as the substitute crop. In India it is grown in Madhya Pradesh, Uttar Pradesh, Andhra Pradesh, Bihar, Tamil Nadu, Karnataka, Maharashtra.

1.2.3. **Botanical description**

It is as herbaceous annual which tillers sparsely. These are generally short plant with height nearly 60 to 120cm. It has slender stem with fibrous and shallow roots. The leaves are hairy with flat and glabrous structure without ligule. The inflorescence is a panicle with densely crowded unawned spikelets. Spikelets are densely packed in three to five rows. The spikelets are subsided by two glumes within which there are two florets. Colour of the glume varies from white to red. The caryopsis remains enclosed in the lemma and palea. Colour of the grain is generally yellow or white.

1.2.4. **Morphological description**

PARTICULARS	**OBSERVATIONS**
Duration	75-95 days
Pigmentation	Green
Tillering ability	High
Panicles	Compact / loose
Grain character	Yellow/ brownish grey

1.2.5. **Climatic requirements**

Barnyard millet grown as a rainfed crop as it a drought tolerant crop. It can be grown successfully under partially water logged conditions. It is grown from sea level to an altitude of 2000 metres on the Himalayan slopes. Warm and moderately humid climate is good for raising barnyard millet crop. It is a hardy crop and is able to withstand adverse conditions of weather better than other cereals.

1.2.6. **Soil**

Barnyard millet is generally cultivated in soils of marginal fertility. It can be grown in partially water logged soils such as low lands on the banks of rivers etc. But it thrives best on sandy loam to loam soil having sufficient amount of organic matter. Gravely and stony soils with poor fertility are not suitable for raising barnyard millet crop.

1.2.7. **Field Preparation**

Since it is cultivated in very light and marginal soils, the land is given only a limited preparatory cultivation. Two ploughings with local plough or harrowing followed by planking are sufficient to prepare the seedbed for barnyard millet.

1.2.8. **Seed and Sowing**

Barnyard millet can be sown in the first fortnight of July with the onset of monsoon rains. The seed is broadcast or drilled in furrows 3-4 centimetre deep at the rate of 8-10 kg per hectare.

Transplanting is also done in some places in Maharashtra. It is always better to sow it in rows 25 centimetre apart. In flood affected areas, it is sown with the first showers of rain by broadcast method and harvested before the flood may come.

1.2.9. **Manures and Fertilisers**

Farm yard manure of compost at the rate of 5 to 10 tonnes per hectare should be added for boosting the yield. It can be supplemented with 40 kg nitrogen, 30 kg P_2O_5 and 50 kg K_2O per hectare. All the fertilizer should be added in the soil at the time of sowing. If irrigation facilities are available, half of the nitrogen should be top dressed in standing crop after 25-30 days of sowing.

1.2.10. **Water Management**

Generally barnyard millet does not require any irrigation. However, if dry spell prevails for a long period, then one irrigation must be given at the time of panicle initiation stage. It is always better if excess water of heavy rains is drained out of the field.

1.2.11. **Weed Control**

The field should be kept weed free up to 25-30 days after sowing. Two weedings are sufficient to control the weeds in barnyard millet field. Weedings may be done with hand hoe or wheel hoe in line sown crop.

1.3. **DISEASES IN BARNYARD MILLET PLANTS**

1.3.1. **Downy Mildew**

It is caused by a fungus. Sometimes it may cause severe damage to the crop plants. In the beginning the light yellow bands are seen on the leaves which in due course of time become white. Later on leaves start drying and in case of severe infection earheads become chaffy. Remove the infected plants and destroy them. Use seed from healthy plants only.

1.3.2. **Smut**

It is also caused by a fungus. The affected panicles are full of black masses instead of grains. This is a seed-borne disease and can be controlled by treating the seed with Agrosan G.N. or Ceresan at the rate of 2.5 g per kg of seed of hot water treatment (soaking seed in hot water at 550C for 7-12 minutes).

1.3.3. **Rust**

It is caused by a fungus. Black spots are seen in lines on leaves. It causes considerable reduction in grain yield. Spray of Dithane M-45 at the rate of 2 kg in 1000 litres of water per hectare may check the spread of this disease.

1.3.4. **Insect Pests**

Stem borer can be controlled by applying 15 kg Thimet granules per hectare.

1.3.5. **Harvesting and Threshing**

The crop should be harvested when it is ripe. It is cut from the ground level with the help of sickles and stacked in the field for about a week before threshing. Threshing is done by trampling under the feet of bullocks.

1.3.5. **Yield**

The average yield of grain is 400 to 600 kg per hectare and that of fodder or straw around 1200 kg per hectare. With improved package of practices it is possible to harvest 10-12 quintals of grain per hectare.

1.5. **DIFFERENT NAMES ASSOCIATED WITH BARNYARD MILLETs**

Bengali	Shyama
Hindi	Sanwa
Kannada	Oodalu
Telgu	Udale, Kodisama
Oriya	Khira
Punjabi	Swank
Tamil	Kuthiraivolly

1.6. NUTRITIONAL QUANTITY (Monteiro et al., 1987)

COMPONENTS	**AMOUNT (gm/mg)**
Protein	11.2
Fibre	10.1
Minerals	4.4
Iron	15.2 mg
Calcium	11 mg

1.7. NUTRITIONAL IMPORTANCE AND ANTINUTRITIONAL COMPUNDS

Barnyard millet grown under natural precipitation mainly in summer for both food and fodder, it is tolerant to draught and can grow in marginal environment. It contain higher protein content than other wild species of barnyard millet since in case of minerals it is just the reverse, from this it is suggested that wild species consist of greater proportion of endosperm because of selection of large seeds that increases the endosperm size.

Wild barnyard millet contains high amount of dietary fibre and non-starchy polysaccharide because of the present of 65% of carbohydrate contain. during digestion it helps in prevention of constipation, lowering of blood cholesterol and slow release of

glucose into the blood stream. In compare to other millets it is very effective in reducing blood glucose and lipid levels (Krishna Kumari and Thayumanavan 1998).

Recently, the demand of barnyard millet has increased due to its highly nutritious grains and strong antioxidant compounds (Watanabe 1999). Scientists have isolated mainly three antioxidative compounds such as one from serotonin derivative, two from flavonoids. These properties of barnyard millet make it as a functional food crop (Kim et al. 2011), it is a gluten free crop used as a substitute of wheat.

Presence of antinutrients such as phylate, polyphenols, oxalates and tannis make the crop mineral bioavailability and form complexes with dietary minerals such as zinc and iron. This highly nutritious crop is very beneficial for human consumption and maintains good health persons those who are allergic to gluten are recommended to have these millets in their diet.

1.8. Top five benifits of barnyard millet

1.8.1. Rich in fibre

It is an excellent source of dietary fibre with a good amount of bot soluble and insoluble fractions. The grain encompasses the highest amount of fibre in comparison to other grain and millets with a serve providing 2-4gms of fibre. According to a study published in the journal of *Food Science and Technology,* the dietary fibre content of barnyard millet was high (12.6%) including soluble (4.2%) and insoluble (8.4%) fractions. The high fibre content helps in preventing constipation, excess gas, bloating and cramping.

1.8.2. Low glycemic index

The carbohydrate content of barnyard millet is low and slowly digestible making the barnyard millet a low gyycemic index food. The carbohydrates in millets shows a high degree of retrogradation of amylase, which facilitate the formation of higher amounts of resistant starch. Hence it can be potentially recommended for patients with cardiovascular disease and diabetes mellitus. In today's scenario millets becomes one of the ideal foods for diabetics.

1.8.3. Gluten free

Like all millets, the barnyard millet is gluten free. It is an appropriate food for patients who are intolerant to gluten (those with celiac disease) or looking to follow a gluten free lifestyle which eliminates wheat, barley, rye- based foods. The millet being easily available, quick to cook and good to taste proves to be an ideal wholesome alternative for rice and other millets.

1.8.4. Good source of iron

According to research on nutrient content on millets, some variety of barnyard millet have shown to contain high amount of iron (18.6mg in 100g of raw millet) which is highest among all millets and cereal grains. It is a good source of iron for vegetarian.

1.8.5. Low in calorie

Barnyard millet is a good source of highly digestible protein and at the same time is least caloric dense compared to all other cereals. It is a grain which makes one feel light and energetic after consumption. A serving of barnyard millets (25g, raw) gives 75 calories and 1.5g of protein.

1.9. HEALTH BENEFITS OF BARNYARD MILLET

1.9.1. Fight type-II diabetes

It is a rich source of magnesium makes many carbohydrate digesting enzymes, even the ones which manage insulin's action. Researchers find that magnesium rich whole grain consumption can help lower the risk of type-II diabetes. In addition to this, low fat diatry fibre owing the presence of calcium also reduce the risk of diabetes .

1.9.2. Millets are as nutritious as fruits and vegetables

According to the research, most of the studies have explored the free forms of antioxidants seen in fruits and vegetables but the difference in millets is it is present in the bound form which needs to be released on fermentation by bacteria thus health benefits of millets is as par as fruits and vegetables.

1.9.3. Fight heart diseases

One of the phytonutrients present in millet is lignans. Lignans are known to be prebiotic fibre which is fermented in our gut by bacteria. Upon fermentation they yield enterolactone, a product which is known to protect against heart diseases and also some kind of breast cancer.

1.9.4. Prevents gallstones

Studies have shown that consuming foods rich in insoluble fibre has the ability to prevent the occurrence of gallstones. It was found that the people eating both soluble and non soluble fibre reported 13% lower risk of gallstones. However, those who ate more of insoluble fibre reported a greater risk reduction in the occurance of gallstones that is around 17%. Thus millet is a good preventive source of gallstone.

1.9.5. Role in asthma

Combination of whole grain with millet like fish helps in reduces the incidence of wheezing and as it is gluten free it is tolerant to all the consumer without any side effects. Thus consuming millets reduces the breathing problems.

1.10. BARNYARD MILLET AS AN IDEAL FOOD FOR DIABETES MELLITUS

A study was undertaken by *Roopashree ugare, et al.,* (2014), which shows the nutritional qualities of barnyard millets. It shows that the barnyard millet is a rich source of protein and fat with low carbohydrate and highly digestible dietary fibre. It contains low gylcemic

index which serves major health benefits in type-II diabetes. In this experiment both dehulled and heat treated barnyard millet was given to the diabetic patients and normal people for 28 days, the study reveals that there is a significant reduction in the glucose level in the patients of diabetic groups and marginal changes in non diabetic groups due to barnyard millet intervention. Thus the study indicate that the dehulled and heat treated barnyard millet is beneficial for type-II diabetes.

1.10.1. **Overview of the experiment**

Barnyard millet was divided into two categories i.e. dehulled and heated treated (heated at 60℃, in four cycle with intermittent cooling for 1hr) and fed to volunteer with diabetics and non- diabetic for certain period of time and then assessed to test carbohydrate(glucose) content by following the methods of *Wolever et al,. (1991).* Thus the long time feeding study with barnyard millet with diabetic and non diabetic volunteer shows that the glycemic index of both dehulled and heat treated grains were found to be lower than glucose. The GI of dehulled grains ranged from 45.2 to 54.8 with mean of 50.0. while the mean GI of dehulled heat treated was 41.7 which is lower than the dehulled grains. Studies shows that the heating renders the starch fraction resistance to enzymes thus helps in digestion. Thus barnyard millets shows improved carbohydrate tolerance among both diabetic and non diabetic volunteer by reducing plasma glucose level.

According to the study by *Krishna Kumari and Thayumanavan(1997),* where the diets prepared from barnyard millet starch is fed to the rats and it was recorded that there is low blood glucose level, serum cholesterol and triglycerides in the blood sample of the rat. Thus there is a need to assess the effect of barnyard millet for its nutritional qualities and potential health benefits among normal and diabetic volunteers.

1.11. **BARNYARD MILLET AS AN IDEAL FOOD FOR CELIAC PATIENT**

Celiac disease – It is a serious autoimmune disorder that can occur in genetically predisposed people where the ingestion of gluten leads to damage in the small intestine.

When people with celiac disease eat gluten (a protein), their body mounts an immune response that attacks the small intestine. These attacks leads to damage on the villi, small fingerlike projections that line the small intestine, that promote nutrient absorbtion. When the villi get damaged, nutrient cannot be absorbed by the body. Thus the only treatment for the disease is lifelong adherence to gluten free diet which is well served by barnyard millet, it is a good substitute for wheat which is saptle food for our country. Barnyard millet serves all the major nutrients which makes it a perfect diet for the celiac patient as it does not contain gluten and but serve all the major and minor nutrients in a sufficient amount need by our body.

Celiac disease leads to – *Ventura, et al. (1999).*

1.11.1. Iron deficiency Anemia

1.11.2. Infertility

1.11.3. Vitamin and mineral deficiency

1.11.4. Pancreatic insufficiency

1.11.5. Gall bladder malfunction

1.13. **Reasons for underutilization of barnyard millets**

- Minimal inclusion in ready-to-eat or ready-to use convenience food product
- Lack of research
- Lack of processing
- Antinutrtional factors
- Low market value
- Less public awareness
-

CHAPTER 2

2. OBJECTIVES

2.1. Optimization of the formulation and technology to develop ready-to-cook gluten free kheer mix.

2.2. To study the physiochemical composition of the kheer mix.

2.3. To study the shelf life of the mix.

CHAPTER 3

3. PROBLEM OF BACKGROUND

According to the study of present scenario most people are suffering from gluten intolerance, which include celiac disease, non-celiac gluten sensitivity, gluten ataxia, dermatitis herpetiformis and wheat allergy. Barnyard millets which is a good source of protein, is also gluten free millet which can be an alternative for the kheer and helps in preventing celiac disease.

CHAPTER 4

4. REVIEW OF LITERATURE

4.1. VALUE ADDED FOOD FORMULATION FROM BARNYARD MILLET

shweta Joshi et al., 2013. Examined about the preparation of khichdi for diabetics utilizing barnyard millet as a substitute of rice. Diabetes is an exceptionally basic sickness among the general population these days which happen because of the expansion of glucose in the blood. It is a condition in which the concentrations of glucose in the body increses of the fact that the body does not deliver insulin in adequate sum or the cells don't react to the insulin create by the pancreas. Khichdi is a customary food of india arranged from the rice and pulses, since rice is rich in high glycemic index it is viewed as unacceptable for the diabetic patients hence, substituting it with barnyard millet having low glycemic index is a decent choice for the diabetic patients. In the present investigation was done to check the differance in nutritional arrangement of barnyard millet khidchi and rice khichdi. As indicated by the outcome it was inferred that with the charbohydrate and physiological energy and other proximate qualities including protein, fat, crude fiber, ash content and different minerals like calcium, phosphorous, press, zinc, manganese and chromium of barnyard millet is higher than the rice khichdi. The barnyard millet khichdi additionally demonstrates low glycemic index and along these lines it was demonstrated that the barnyard millet khichdi is the best substitute for the diabetic patients.

Key words: diabetes mellitus – glycemic list – khicdhi

Naznl P et al., 2016. Contemplated the advancement and assessment of Barnyard millet grain incorporated rusk and muffin. Since barnyard millet give a decent source of all the basic supplements for our wellbeing, the millet as well as the millet bran is likewise utilized as a result of millet based nourishment producing. In the present investigation the stable area millet grain is treated with different chemicals to reduse the antinutritional factors (ANF) for example :-

Treatment 1: Mix grain and soak with 20% 1% acidic acid and separated and again soak in sodiumbicarbonate solution, at long last sifted and dried.

Treatment 2: Soaking bran in boiling water (125℃) for 15min, separated and blended with 20% arrangement of 1% calcium hydroxide at long last sifted and dried at 50℃.

Treatment 3: Bran is washed in water and dried overnight at 50℃. At that point blended with 0.5mol citrus extract at the proportion 1:12 and mixing for 30min. the acid slurry is dried for 24 hr to expel the residual alkali.

These treated bran were joined to make rusk and muffin which were acknowledged and pass all the sensory traits. The incorporation of barnyard millet wheat increment the hadrness of rusk and muffins and expands its quality.

Key words: antinutritional factors – biscuit – glycemic record

Surekha N et al., 2013. Built up an esteem included low glycemic index barnyard millet noodles. barnyard millet is an underutilized millet with high wholesome quality and low glycemic index as low glycemic sustenance is successful in overseeing diabetes mellitus. It give all macro and small micro nutrient supplements. It is a decent source of neutraceutical parts. As noodles are the most favored sustenance among all age in this way, the present investigation was to plan low glycemic noodle. For this barnyard millet flour is consolidated with sago flour, pulse flour and bengal gram leaf flour at various extents to build up a plain, pulse and vegetable noodles and after that they were assessed for nutritional composition and glycemic index. The investigation demonstrates that the noodles arranged from pulse and vegetable contain more wholesome esteem and there glycemic content is not as much as the plain noodle. Accordingly the prepared low glycemic noodle is best for diabetic patiets.

Key words: noodles – neutraceutical – glycemic list - consolidation

4.2 SENSORY EVALUATION OF KHEER MIX

*Shahid Ahmed et al., 2016,*It was studied that the development of multigrain porridge mix. The experiment was mainly based on sensory evaluation by various tests for sensory quality like colour, appearance, body and texture, flavour and sweetness and overall acceptance. In this study the grains are steamed at 115˚, 15psi for 15 min and then spread into thin layer to aloe to dry in a tray dryer up to 5-6 % moisture content. Then the dehydrated grains were roasted in hydrogenated fat at 120˚c for 5min and then blended with milk powder and powdered sugar and sensory characteristics were analysed.

Key words: sensory – dehydrated – porridge – multigrain

B.R.Kadam et al.,2011. The examination was embraced to figure kheer prepared blend utilizing Basmati rice, powdered unadulterated sweetener and drain powder in various extents and to dissect the tangible factors by utilizing saffron shading to the kheer. This test indicate changes in shading with no change in tactile properties.

Shaikh Adil et al., 2015. The target of this examination was to assess the time span of usability and tactile traits of pumpkin seed when put away at10˚c for 3 days, with five distinct medicines, for example, T1(pumpkin substance kheer), T2(1% pumpkin powder + 43 percent skim drain powder), T3(2% pumpkin powder + 42 percent skim drain powder), T4(3 % pumpkin powder + 41 percent skim drain powder), T5(4 % pumpkin powder + 40 percent skim drain powder). The examination uncovered that both the capacity time frame and medicines have impacts on tactile characteristics and it diminishes with the progression of capacity period.

Key words: shelf life – sensory – pumpkin seed

4.3 OPTIMIZATION OF SHELF LIFE

Alok Jha et al.,2012. The examination was embraced to decide the timeframe of realistic usability of Instant kheer blend powder and advancement of time span of usability by utilizing spray drying innovation. To test the timeframe of realistic usability the kheer blend powder was put away at 30˚, 37˚ and 45˚c which demonstrates different physiochemical changes. The aggregate and free Hydraoxymethylfurfural (HFM) arrangement capacity was observed to be expanded. The timeframe of realistic usability was anticipated by and connection amongst chemical and sensory parameters and was 37˚c.

Key words: splash drying – physiochemical – HFM - motor consistent

Bhanu Pratap Singh et al.,2013. The investigation was attempted to assess the timeframe of realistic usability for multigrain Dalia blend including Sorghum, pearl millet and Maize. The Dalia blend was put away at 10, 20, 37 and 40˚c for 180 days which expands the estimation of Hydroxymethyl Furfural(HFM), free fatty acids(FFA) for the item with increment in temperature and capacity period. It was anticipated that the timeframe of realistic usability for the multigrain dalia blend was 71 weeks at 10˚c.

Key words: multigrain – free unsaturated fat – HFM - dalia

S. Balasmbramanian et al.,2012. The examination was completed to assess the improvement and timeframe of realistic usability of pearl millet based upma dry blend. Pearl millet contain high anti nutritional factors so they were dealt with to lessen the impact and inactivate the movement of lipase compound. The investigation was planned with central composite rotatable design (CCRD), with three free factor for rehydration. These redydration and sensory response proportion were utilized to consider the individual and intuitive impacts of factors. The arranged upma blend was additionally researched for peroxide, free unsaturated fats and thiobarbituric value and put away to check the capacity and stability of the blend.

Key words: control composite rotatable design (CCRD) – rehydration – free fatty acid – upma

4.4 STUDIES ON PHYSICO-CHEMICAL PROPERTIES OF KHEER

Alok jha et al.,2002. The examination was led to consider the physio-chemical properties of instant kheer blend. In this investigation buffalo milk was standardise by vacuum focus and different materials, for example, ground rice flour and sugar were preheated and a slurry was set up for the gelatinization of the starch. These blend were exchanged to the spray drier at temperature of 170℃for inlet and 86℃for the outlet for changing over them in the powdered frame. The powder was then blended with ground sugar through dry mixing, the instant blend was examined for its flowability, mass thickness, interstitial air content, crude fiber, insolubility record, porosity and dispersibility.

Key words: flowability – gelatinization – mass thickness - dispersibility

Anita kashyap et al.,2018. The examination was done to consider the physico-chemical properties of kheer mix. Each one of the parameters like, mass thickness, molecule thickness and cooking time were explored and it was found that the expanded millet coarseness in kheer mix reduces the particle thickness and porosity rate and this in like manner constructs the cooking time, subsequently as demonstrated by the examination the fuse level of corn meal is directly proportional with the time required for course of action

Key words: porosity - joining – molecule thickness

Sengev et al.,2012. Research was completed for the physiochemical and sensory properties of instant Kunun-Zaki flour mixes with sorghum and mango mesocarp flours. Instant Kunn-zaki, an aged non alcoholic sorghum drink was set up by blending distinctive arrangement and there useful and chemical properties were studied. The investigation demonstrates that the β-carotene content additionally expanded with expanded arrangement of mango mesocarp flour, it likewise demonstrates the expansion in hygroscopicity while diminish in consistency of the mixes. In this way the expansion of mango mesocarp flour increase the ash, crude fiber and introduce β-carotene with the item.

Key words: kanun-zaki flour – mesocarp – hygroscopicity – β-carotene

J.R.Pariskar et al.,2015 .The examination was embraced on the investigation of chemical composition of kheer arranged from soy drain mixed with buffalo milk. The level of sugar

was kept consistent and the milk composition was changed in various treatments as T1(100:00), T2(90:10), T3(80:20), T4(80:30). This adjustment in composition demonstrates that there is increment in protein, moisture and titrable acidity as the extent of soy drain composition in the mix, Fat, add up to solids, add up to sugar and ash content declines with addisition of soy drain in the mix.

Key words: tritable acridity – soy drain – mix

D.M.Bhusna et al., 2015. The examination was embraced to think about the chemical composition of kheer arranged from dairy animals drain and mixed with sweet potato with five distinct blends of milk and sweet potato paste as 97.5 percent cow milk with 2.50 percent rice (T1-control), 95:05(T2), 90:10(T3), 85:15(T4), 80:20(T). It was discovered that the most extreme fat, protein, add up to sugar, ash and total solids content was recorded in kheer arranged from 97.50 percent cow milk with 2.50 percent rice, while the greatest moisture and SNF content was recorded in T5.

Key words: SNF – add up to strong

Manoj Kumar R. Sulenkhe et al.,2015.The investigation was carried for assessing the fortification for kheer sustained with carrot shreds. With various composition four example of milk and carrot shreds are mixed as T1(90:10), T2(85:15), T3(80:20), T4(75:25), was set up with sugar and cardamom. It was discovered that carrot shreds influence the physiochemical organization as the fat, moisture and protein content declines with increment in the measure of carrot shreds while the total solid and ash content increments. Along these lines T2 demonstrates the greatest sensory score.

4.5 OPTIMIZATION OF THE FORMULATION AND TECHNOLOGY TO

Alok jha et al., 2013. The investigation was completed for the study of instant dalia pre-blend utilizing response surface technique to build the timeframe of realistic usability of the item. In this investigation a central composite rotatable design (CCRD) was utilized to check the impact of various levels of milk solids and wheat solids. It was discovered that the 17.82% 0f milk solid and 2.87% of wheat solids is the most proper detailing for the dalia blend.

Key words: CCRD – dalia – reaction surface procedure

Durga Shankar Bunkar et al., 2012. The target of this examination was to upgrade the way toward assembling instant kheer blend in view of pearl millet rather than rice. Different composition of sugar15g, dairy whitener30g, pearl millet20g where planned to analyse the scores of consistency, cohesiveness and overall acceptibility. As indicated by the examination the fat, protein, moisture, ash, carbohydrate remains content as 2.8%, 4.38%, 5.84%, 85.88% and 1.1% separately. It was inferred that general agreeableness score as 7.66% and attractive quality file of 0.7663%.

Key words: cohesiveness – pearl millet

Kabita C Sarma et al., 2016. The examination was attempted to create prepared to-cook instant kheer blend with various components like sugar, rice, water and refined flour and made a mixture roughly 0.8cm long and 0.2cm thick structures, dried in sun for 2-3 days. The innovative technique is revealed that there is no additive and does not require soaking for long time.

Smita single et al.,2013. Directed took a shot at the arrangement of instant blend by extrution innovation with precooked rice granules. The investigation demonstrates the impact of screw speed, moisture, mass thickness, temperature, water absorbtion index, water solubility index and starch change on the instant blend arranged by extrution innovation. Advance in the trial skim drain powder and sugar was institutionalized and contemplated for the capacity and time span of usability of the item and checked for the overall sensory assessment.

Key words: moment blend – extrution – institutionalization – mass thickness

CHAPTER 5

5. MATERIALS AND METHODS

PROCUREMENT OF RAW MATERIAL

The present investigation on formulation of "Gluten free ready-to-cook kheer mix" is planned with different combination of barnyard millet purchased from the local market of Siliguri, India, soy milk powder from online store, dates and dry fruits from local market of Phagwara, Punjab.

PHYSIOCHEMICAL ANALYSIS:

5.1 Determination of Moisture Content

Moisture content of the sample was estimated by oven drying method (A.O.A.C., 2005). The sample was taken in triplicates. The 5gms of sample was added to each bottle accurately (previously heated to 90°c to 100°c and cooled in desiccators). The bottles contacting sample were loosely covered with lids, and transferred to oven and were heated at 105°c for 3 hours. After 3 hours, bottles were removed from oven and allowed to cool in the desiccators and where weighed accurately. Then again bottles were returned to oven for 1-hour and weighed. This process was repeated until the constant weight were observed. Moisture content of the sample can be calculated using the formula

$$\text{Moisture content of sample (\%)} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,

W_1 = initial weight of bottle with sample before drying.

W_2= final weight of the sample after drying.

5.2 Estimation of Total Minerals

The total mineral content of the sample was determined by the ashing method (A.O.A.C., 2005). Set the temperature of muffle furnace to 600°c and heat the empty crucible for 1 hour and transfer into desiccators and let them cool to room temperature. Then take the weight of the crucible as (W_1). Weigh about 2-5gms of the sample into the pre-weighed crucible and take the weight again (W_2). Heat the crucible cautiously at low flame until

the materials begin to char and continue heating till the charring is complete. After charring transfer the crucible to the preheated muffle furnace (550-600°c), incinerate the sample for 4-6 hours until ash of white or light grey is obtained. Transfer the crucible into desiccators and let them cool to room temperature and weigh (W_3). Repeat the procedure until two consecutive readings are obtained the same. Total mineral content of the sample was calculated by using the formula,

$$\text{Percentage of ash in the sample (\%)} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

where,

W_1 = weight of the empty crucible

W_2 = weight of the crucible with sample

W_3 = weight of the crucible with ash

5.3 Determination of Protein Content

The protein content of the given sample was determined by micro- kjedhal method (A.O.A.C., 1990). The powdered sample was taken and 200mg of the sample is accurately weighed and transferred into digestion flask to which catalyst mixture and thoroughly mixed the sample. Then concentrated sulphuric acid and hydrogen peroxide is added carefully and sample was digested in digestion chamber. The digestion of the sample is continued until the sample became colourless and clear. Then the flask was allowed to cool and to dissolve the solids the water is added in the flask. After cooling the contents were added to volumetric flasks. The digestion flask was washed 3-4 times and volume was made up to 50ml in the volumetric flask. Boric acid solution was pipette into a beaker and 6-8 drops of mixed indicator was added. the beaker was placed under condenser of distillation assembly.ml of digest was pipette into distillation flask and 10 ml of sodium hydroxide is added and mixed thoroughly. This process was done till the 50ml of the distillate was obtained and then tip of the condenser was washed to collect the ammonia and conformation of the distillation was made with the litmus paper. The distillate collected was then titrated with 0.02N Standard Hydrochloric acid. the colour changes

from pinkish red to bluish green and that the end point of the titration. Simultaneously, blank titration was also carried out each time. The percentage of nitrogen content was calculated from the volume of 0.02 N hydrochloric acid required during titration. The percentage of nitrogen was calculated by multiplying the nitrogen content by a factor 6.25 (A.O.A.C., 1990).

$$\text{Nitrogen (\%)} = \frac{(S-B) \times N \times 14.007}{\text{Weight of sample (gm)}} \times \frac{\text{Volume made}}{\text{Volume taken}} \times 100$$

Where,

S : ml of hydrochloric acid required for sample titration.

B : ml of hydrochloric acid required for blank titration

N : Normality of HCl (0.02)

Protein (%) = nitrogen (%) x 6.25

5.4 Determination of Total Fat Content

The total fat content of the sample was estimated by soxhlet method (A.O.A.C., 2005). The soxhlet flask of 250 ml was cleaned and dried in an oven. Record the weight of the empty flask. Add 5gms of sample in pre-weighed thimble and plugged with fat free cotton. Then record the weight of the thimble with sample and place the thimble in the siphon portion of the soxhlet apparatus. The mixture of petroleum ether and diethyl ether was added in the round bottom flask of the soxhlet's apparatus and it was connected to siphon and condenser. The condenser was plugged with moistened cotton. It was refluxed for 5-7 times at 60°c. then the ether was distilled off and the flask was placed on a hot plate for 3 hours at 105°c for drying, and then cooled in a desiccator and weighed. Total fat content of the sample can be calculated by the formula

$$\text{Fat content (\%)} = \frac{W_2 - W_1}{} \times 100$$

X

Where,

W_1 = weight of empty round bottom flask

W_2 = weight of round bottom flask after extraction

X = weight of the sample

5.5 Determination of Total Carbohydrate Content

The total carbohydrate content was determined by enthrone method (N.I.N.,1983).

Standard preparation:

Stock solution was prepared by dissolving 100 mg of glucose in 100 ml beaker. Take working solutions of 0,0.2,0.4,0.6,0.8 and 1.0 ml and make up the volume for 1 ml by adding distilled water.

Sample Preparation:

Weigh accurately 100 gms of sample into boiling tube and was hydrolysed by keeping in water bath for 3hrs with 5 ml of 2.5 ml of HCl and cooled to room temperature. And neutralize the extract with solid sodium carbonate until the effervesces ceases. Make up the volume to 100 ml in a volumetric flask and centrifuge. Collect the supernant solution and take 0.5 ml and 1.0 ml aliquots for analysis in to test tubes. Make up the volume to 1ml with distilled water.

Calibration of standard curve:

Add 4 ml of reagent to all the Standard and sample test tubes and heat in a boiling water bath for 8 minutes. Cool rapidly, a green to bluish green colour develops and read at 630nm. Plot the standard graph for different concentrations of the standard and derive the concentration of unknown sample by intercepting the graph.

$$\text{Amount of carbohydrates (mg \%)} = \frac{\text{mg. Of glucose}}{\text{Volume of test sample}} \times 100$$

5.6 Determination of Total Sugar:

The total sugar content of the sample extracted in the aqueous solution (80% ethanol) was determined by the method of Nelson.

The sample was ground into powder and 1gm of sample was extracted with 10 ml of 80% ethanol (boiling). The extraction was repeated 4 times by centrifugation at 10000 x g for 15 min. the ethanol extraction was evaporated to about 100 ml with water. The aqueous extract was used for the determination of reducing sugars. Take 25 ml of the extract in 50 ml volumetric flask to this add hydrochloric acid and ethanol in 1:1 ratio and placed in hot water bath for 30 min. then neutralise with sodium hydroxide and make up the volume to 50 ml. this solution is use for determination of total sugars.

To 1 ml of the sample extract add 1 ml of copper sulphate reagent, mix it thoroughly and heat for 20 mins in boiling hot water bath. Then cool the solution and add 1 ml of arsenomolibdate reagent. The mixture was dilute to 8 ml and optical density was measured at 520 nm. The total sugar content was calculated from a standard curve prepared by the same procedure by D-glucose at concentrations of 0, 10, 10, 30, 40 and 50 µg/ml

5.7 Estimation of Crude Fibre

Crude fibber content of the sample was determined by the method of A.O.A.C (1990). Weigh accurately 2.0 grams of moisture and fat free sample in 500 ml beaker. Then 2ooml of 0.225 N sulphuric acid is added into the mixture was allowed to boil for 30 mins keeping the volume constant by addition of water at frequent intervals, glass rod was used to stir the solution which helped for smooth boiling. The mixture was filtered through muslin cloth and residue was made acid free by washing the mixture with hot water. then transfer it to beaker and add 200ml of 0.313 N sodium hydroxide and boiled for 10 min keeping the volume constant with distilled water. Then filter the mixture using muslin

cloth and make it alcohol and alkali free by washing it with hot water. Then residue was transferred to crucible and oven dried over night at 80°c and weighed accurately (W_1). The crucible was heated in muffle furnace at 600°c for 2-3 hours and then cool it in desiccator and weighed again accurately (W_2). The difference between the two weights was considered as the weight of crude fibre in the moisture and fat free sample. The crude fiber content of the given sample is calculated by formula

$$\text{Crude fibre content (g/100g)} = \frac{(W_1 - W_2)}{\text{Weight of sample}} \times 100$$

5.8 Determination of Energy Content

The energy content of the sample was computed by summing up the values obtained by multiplying the values with Atwater constants for carbohydrates with 4, crude fat with 9 and proteins with 4 (N.I.N., 1983).

5.10. Calcium content

The calcium content of the sample was estimated by EDTA titration method.

0.5 g of sample which was previously oven dried was taken in 250 ml conical flask and 10 ml of nitric acid was added to the conical flask and was placed over night undisturbed. then add 5ml of H_2O_2 to the flak and was heated on hot plate until the solution was decreased to 1-2 ml in the flask they were cooled to room temperature and was diluted by using distilled water by rinsing through neck. contents were transferred to 100 ml volumetric flask and volume is made up and was filters. Aliquots of 0.5 ml were prepared and 5 drops of 4 N sodium hydroxide and 50 mg of ammonium purpurate as indicator it was added. This solution mixture was titrated with EDTA and colour change was noted as end point from orange red to lavender purple. The volume of 0.01 N EDTA solution was required to neutralise the sample was noted and given by the formula.

$$\text{R x Normality of EDTA x 1000 x 5}$$

Ca (me/lit)(a) = ----------

Aliquot (ml) taken

5.11. Hygroscopicity

Hygroscopicity was determined according to the method proposed by Tonon *et al*. (2008) with some modifications. Approximately 1g of powdered sample was placed at room temperature in plastic container containing saturated solution of sodium chloride (75.29% RH). After one week, the samples was weighed and hygroscopicity was expressed as grams of adsorbed moisture per 100 g dry solids and calculated, using the following equation:

Hygroscopicity = [Δm / (M+Mi) / (1+ Δm/M)]

Where Δm (g) is the increase in weight of powder after equilibrium, M is the initial mass powder and Mi (%, wb) is the free water contents of the powder before exposing to the humid air environment

5.12. Water absorption index (WAI)

WAI of product was determined following the procedure given by Ahmed *et al*. (2010).in which a weighed sample of 2.5 g was suspended in 50 ml tared centrifuge tubes containing 30 ml of distilled water. The sample was stirred intermittently over a period of 30 minutes and centrifuged at 3000 rpm×*g* for 10 min. The supernatant liquid so obtained was poured carefully into a tared evaporating dish for calculating water solubility index. The remaining gel was weighed and the water absorption index was calculated as follows

$$\text{Water absorption index (WAI)} = \frac{\text{weight of gel} - \text{weight of ground dry sample}}{\text{weight of ground dry sample}}$$

5.13. Water solubility index

The solubility of the kheer mix powder was carried out according to Cano-Chauca *et al.* (2005). The peel powder was weighed and homogenized by grinding 1 g of powder in 100 ml of distilled water in the blender for 5 min at high speed. The solution was then centrifuged at 3000×g for 10 min. An aliquot of 25 ml of the supernatant was transferred to pre-weighed Petri dishes and oven-dried at 105°C overnight. The solubility (%) was calculated by weight difference.

5.14. Flowability

5.15. Bulk density

The bulk density (g/ml) of the sample was determined following the method adopted by Muzaffar and Kumar, (2016). For the determination of loose bulk density a known quantity of powder sample was freely poured into a 10 ml graduated cylinder (readable at 0.1 ml) and the volume occupied was noted and then used to calculate bulk density (weight/volume).

$$\text{Bulk Density} = \frac{\text{Mass of powder}}{\text{volume}}$$

5.17. Total phenolic content and surface phenolic content

The total phenolic content in different encapsulated samples were determined Folin Ciocalteu's procedure given by Icyer, 2012, in which 1 gm of sample was taken in a screw caped vial, to this ten ml of distilled boiled water was added and the contents were mantained at 100°C for 5 minutes for proper extraction followed by cooling and filitration through a 0.45 mm filter paper. To this filtrate 0.5 ml of Folin Ciocalteu's reagent was added and mixed well and allowed to stand at room temperature for 7 minutes. After this 1.5mL of 20% (w/w) sodium carbonate solution was in the dark for another 2 h, and the absorbance value of the sample was measured at a wavelength of 765 nm using a UV/VIS Spectrophotometer. on microcapsule surface,

And for the determination of surface phenolics, method was adopted from Zhang *et al*., 2007. 1 g of the sample was taken into a screw-caped vial to which ten ml of absolute ethanol was added, shaked well, and kept at room temperature for 5 minutes for proper extraction. The mixture was filtered through a 0.45 mm filter paper. To this filtrate 0.5 ml of Folin Ciocalteu's reagent (FCR) was added, mixed well and allowed to stand at room temperature for 7 min, followed by the

addition of 1.5mL of 20% (w/w) sodium carbonate solution, mixed well and allowed to stand in the dark for 2 hours before measuring absorbance at a wave length of 765 nm and was calculated against the standard curve already prepared.

5.18. Estimation of reducing sugar

Standard titration- Prepared by the method of A.O.A.C pipette 5ml of Fehling's A and 5ml of Fehling's B solution into a 100ml conical flask. Add approximately 8-9ml standard glucose solution from a burette sp that 40-45mg of glucose are added to the flask. Heat the flask till it starts boiling then add 1ml of 0,2% methylene blue solution. Continue titration by adding sugar solution from the burette a few drops at a time and titrate. At the end point the methylene blue turns colorless. The remaining solution is reddish brown. Repeat the titration till concordant values are obtained.

Sample titration- dilute the given sample glucose solution in 100ml volumetric flask to the mark with distilled water. Pipette 5ml of Fehling's A and 5ml of Fehling's B solution into 100ml conical flask. 4-5 ml of the diluted sugar solution from the burette and heat till start boiling and add 1ml of 0.2% methylene blue solution. Continue heating and complete titration by adding sugar solution. Repeat the titration till concordant titre values are obtain

5.21.Sensory evaluation

The samples were evaluated on the basis of color , texture/body, taste and overall acceptibility by semi trained panelof 9-10 judges using 9 point hedionic scale assigning scores 9-like extremely to 1-dislike extremely (Appendix). A score of 5.5 and above was considered acceptable (Amerine *et al,*. 1965)

5.22. Economics of the product

Cost of the product was determined by taking into consideration the cost of raw material, chemicals, packaging materials, overhead charges(Including labour, fuel and machinery depreciation), GST and profit involved in the production of the product.

CHAPTER 6

EXPECTED OUTCOME

Barnyard millet which is an underutilised cereal was used for preparing gluten free kheer. To minimise the risk of celiac disease. To study the shelf life of the instant kheer mix by tray drying method used to increase the nutritional quality and sensory attributes of kheer. The kheer prepared from barnyard millet will serve as a very good source of protein.

CHAPTER 7

7. RESULT AND DISCUSSION

The present study on 'Development of gluten free instant kheer mix' was carried out in the Department of Food Science and Technology, Lovely Professional University, Punjab, India. The results obtained during the investigation are discussed here:

7.1. Properties of raw materials

7.1.1. Proximate analysis of barnyard millet flour

7.1.2. Proximate analysis of soya milk powder

7.1.3. Pasting characteristics of barnyard millet flour

7.1.4. Composition of soy milk powder

7.2. Processing of instant mix

7.2.1. Bulk density

7.2.2. Water absorption index

7.2.3. Water solubility index

7.2.4. Hygroscopicity

7.2.5. Flowability

7.2.6. Total energy content

7.3. Proximate composition of final mix

7.4. Storage study of final mix

7.5. Economics- cost of the product

6.1. Properties of raw materials

6.1.1. Proximate analysis of raw materials

The data given in Table 6.1 depicts the chemical composition of barnyard millet and soy milk used. Barnyard millet contains 7.5±0.04% moisture, 1.84±0.05% ash *Rizwanullah Rafed et al., (2017)*, 2.91±0.06% fat, 11.54±0.26% protein. *Roopashree Ugare et al., (2014)* reported similar composition of raw material nutrient contents of barnyard millet.

The data given in Table 7.2 depicts the chemical composition of soy milk powder (spray dried). It contains 3.63±0.23% moisture, 19.92±0.08% fat, 61.05±0.23% protein and 1.41±0.02% ash *Ishiwu CN et al., 2014* reported similar composition of nutrient contents of soya milk powder (spray dried) except the protein ad moisture content in the present test were found in less amount.

Table 6.1: Proximal nutrient composition of barnyard millet (n=3)

BARNYARD MILLET	
COMPOSITION	**AMOUNTS**
Moisture	7.5± 0.04
Ash	1.84± 0.05
Protein	11.54± 0.26
Fat	2.91± 0.06

Table 6.2: Proximal nutrient composition of soya milk powder (n=3)

SOYA MILK POWDER	
COMPOSITION	**AMOUNTS**
Moisture	3.63±0.23%
Fat	19.92±0.08%
Protein	61.05± 0.23%
Ash	1.41±0.02

CHAPTER 8

REFERANCE

1. Alok Jha and Ashok Ambalal Patel, (2012). Kinetics of HMF formulation during storage of instant kheer mix powder and development of a shelf-life prediction model; Journal of food processing and preservation.
2. Alok Jha, Ashok Ambalal Patel, Ram Ram Bijoy Singh, (2002). Physio-chemical properties of instant kheer mix; Division of dairy technology, 82:501-513.
3. Alok Jha, B. N. Shalini, Ashok Ambalal Patel, Mithilesh Singh, Prasad Rasane., (2013). Association of Food Scientist & technologist (India).
4. Anita Kashyap, Mayank Mehra, Yogita Kashyap., (2018). Study the physic-chemical attributes of kheer mix; Development of Food Science and Technology., 2856-2857.
5. B.R.Kadam., A.F.Lembhe., P.N.Zanjad., (2011). Formulation of kheer ready-mix based on sensory attributes; Tamilnadu J. Veterinary & Animal Sciences 7:88-93.
6. Bhanu Pratap Singh, Alok Jha, Nitya Sharma and Prasad Rasane, (2013). Optimization of a process and development of a shelf life prediction model for instant multigrain dalia mix; Department of food process engineering, 36:811-823.
7. D.M., Bhusnar, P.A., Kahate, A.S., Chavan and D.V., Hole, (2016). Chemical composition of kheer prepared from cow milk blended with sweet potato (Ipomea Batatas L.); Department of animal husbandary and dairy science, 34:889-892.
8. Durga Shankar Bunkar, Alok Jha, Ankur Mahajan, (2012). Optimization of the formulation and technology of pearl millet based ready-to-reconstitude kheer mix powder; Journal of food science and technology, 51:2404-2414.
9. Ishiwu CN, obiegbuna JE, JO Iwouno., (2014). Effect of inlet-air temperature on physic-chemical and sensory properties of spray-dried soy milk; Department of Food Science and Technology.,14(6):2239-2253.
10. J.R., Pariskar., R.A., Patil, P.V., Padghan, G.K., Londheand and K.S., Bhosale.(2015). Studies on chemical composition of kheer prepared from soy milk blended with buffalo milk; Department of animal husbandry and dairy science, 34:109-112.
11. Kabita C Sarma, Saurabh Sarma and Sk Md Azizur Rahman, (2016). Development of ready-ti-cook instant kheer mix; ICAR krishi vigyan Kendra hailakandi, 5:23-25.

12. Khusboo Gupta, Mansi Verma, Payal Jain and Monika Jain, (2014). Process optimization for producing cowpea added instant kheer mix using response surface methodology; Journal of nutritional health & food engineering, 1:2-9.
13. Manojkumar R. Salunkhe, Pushkraj J. Sawant, Dhruvaraj N. Sawant and Dinesh C. Rai, (2015). Physiochemical analysis and sensory evaluation of kheer fortified with carrot shreds; Department of animal husbandary and dairying, 5:849-853.
14. Ronak Shrimali, Vijay Kumar Gupta, Ganga Sahay Meena, Yogesh Khetra and Raghu., H.V. (2015). Studies on selection of cooking techniques for economic manufacture of kheer mohan from buffalo milk; Dairy technology division, ICAR-National dairy research institude, 68:453-457.
15. S. Balasubramanian, Deep N. Yadav, Jaspreet Kaur, Tanupriya Anand., (2012). Development of shelf-life evaluation of pearl millet based upma dry mix: Association of Food Science & Technology.
16. S.K. Gupta, (1976). Sensory evaluation in food industry; Indian dairyman, 28:293-295.
17. Sarode A.R., Khedkar, S.D., Patil, M.R.,Bajad, D.N., Sarode T.R and Chavhan, S.J.(2004). Studies on microbiological quality of karad-kheer: a value added dairy product of Maharashtra.J. Dairying Foods and H.S. 26:98-101.
18. Sengev, I.A., Akpapunam, M.A. and Ingbian, E.K., (2012). Physiochemical and sensory properties of instant Kunun-zaki flour blends from sorghum and mango mesocarp flours; Official journal of Nigerian institude of food science and technology. 30(2):8-16.
19. Sengev, LA, Akpapunam, M.A. Ingbian, E. K., (2012). Physiochemical and sensory properties of instant Kunun-Zaki flour blends from sorghum and mango mesocarp flours; Official Journal of Nigerian Institude of Food Science and Technology., 2:8-16.
20. Shahid Ahmed., Smita Singh., Yogesh Kumar Rathor., Rajendra Kumar Pandey., (2016). Sensory evaluation of multigrain porridge mix; Life sciences international research journal. 3:119-120.
21. Shaikh Adil., Sudhakar Changade., Anant Dhotre., Santosh Chopde., (2015). Studies on sensory and keeping qualities of pumpkin based kheer; Department of dairy technology, college of dairy technology. 34:270-274.

22. Shivakumar, Arunkumar, H., Venkatesh, M.V., (2014). Process optimization for the production of paneer kheer blended with foxlet millet and finger millet flour; J. Res. Agri. Anim. Sci., 2:6-9.
23. Shivakumar, Arunkumar.H., Venkatesh.M.V., (2014). Process optimization for the production of paneer kheer blended with foxtail millet and finger millet flour; Department of dairy technology, Dairy science college, 2:6-9.
24. Shweta Joshi, Sarita Srivastava., (2015). Barnyard millet as a substitute of rice in preparation of khichdi for diabetics; Department of food and Nutrition., 2319-7064.
25. Suma Divakar, Mary Ukkuru and U. Krishnaja, (2014). Development of a banana-based payasam mix; Department of home science, Kerala agricultural university, 8:41-43.
26. Surekha N, Ravikumar S Naik, Mythri S, Rohini Devi., (2013). Barnyard millet (Echinochloa frumentacea Link) cookies: development, value addition, consumet acceptability, nutritional and shelf life evaluation: Department of Food and Nutrition., 7(3):1-10.