PREPARATION OF *KASAR* AND ITS QUALITY EVALUATION

by

Anjan Kumar Bhattarai

Department of Food Technology

Central Campus of Technology

Institute of Science and Technology

Tribhuvan University, Nepal

2022

PREPARATION OF *KASAR* AND ITS QUALITY EVALUATION

A dissertation submitted to the Department of Food Technology, Central Campus of Technology, Tribhuvan University in partial fulfillment of the requirements for the Degree of B. Tech. in Food Technology.

by

Anjan Kumar Bhattarai

Department of Food Technology

Central Campus of Technology, Dharan

Institute of Science and Technology

Tribhuvan University, Nepal

August, 2022

Tribhuvan University

Institute of Science and Technology

Department of Food Technology

Central Campus of Technology

Approval Letter

This dissertation entitled "*Preparation of kasar and its quality evaluation" by Anjan Kumar Bhattarai* has been accepted as the partial fulfillment of the requirements for the B. Tech in Food Technology.

Dissertation Committee

1. Head of the Department

____

(Mr. Navin Gautam, Asst. Prof.)

2. External Examiner

____

(Mr. Birendra Kumar Yadav, Asst. Prof.)

3. Supervisor

____

(Mr. Navin Gautam, Asst. Prof.)

4. Internal Examiner

____

(Mrs. Mahalaxmi Pradhananga, Asst. Prof.)

August 22, 2022

Acknowledgements

I express my deepest gratitude to my supervisor Asst. Prof, Navin Gautam, Head of department, Department of Food Technology, Central Campus of Technology, for his excellent guidance, valuable suggestions and motivation throughout the work. This project won't have been possible without his continuous involvement and guidance.

Further, I owe my gratitude to assoc. Prof. Dr. Dil Kumar Limbu, campus chief for creating the favorable environment to work by providing necessary equipment.

I also would like to thank lecturer Mahalaxmi Pradhananga for her precious time and suggestion during my dissertation work.

I also owe my heartfelt gratitude towards Mr. Prajwal Bhandari, Mr. Mahesh Shrestha and other laboratory as well as library staffs of Central Campus of Technology for their constant support and valuable time. I have limitless gratitude towards my colleagues Tikaram Pahadi, Samikshya Chhimal, Anup Poudel for their valuable help during the process. I thank you guys for your insight, observations, and contributions that have aided me in some way, whether directly or indirectly. Moreover, I am bound to express my gratitude towards senior Pradip Sangraula, Ojwasbi Krishna Shrestha for helping me whenever required.

Last but not least, I express sincere thanks to all those names which have not been mentioned individually but helped me directly and indirectly in this work.

Date of submission: August 22, 2022

Anjan Kumar Bhattarai

Abstract

The objective of this dissertation was to study different techniques of kasar preparation through survey of the *Brahmin* and *Chhetri* community in Province no. 1, Bagmati, Gandaki and Sudur pashcim provinces and determine the best method for preparation of *kasar*. For the preparation of *kasar,* rice of *kanchhi mansuli* variety, sesame and jaggery was brought from the local market of Dharan. Two methods were screened from the various methods obtained from the survey. First method (Method A, Sample A) entails cleaning, soaking, draining, milling, winnowing, roasting in ghee, mixing with boiled and filtered jaggery and moulding, whereas second method (Method B, Sample B) entails taking rice, cleaning, roasting in ghee, grinding, mixing with jaggery syrup and moulding. The various physical parameters like L/B ratio, bulk density and thousand kernel weight of rice was determined. Proximate analysis of rice and sesame seeds were performed and totals solids, TSS, total sugar, reducing sugar and ash content of jaggery was determined. Best *kasar* was determined by one-way ANOVA (blocking panelist) of sensory score obtained from semi-trained panelist and the proximate analysis of the best sample was performed. Storage stability of *kasar* packed in PP plastic was studied for 60 days via analysis of PV and AV values.

The L/B ratio, bulk density and thousand kernel weight of rice were found to be 2.69, 93 kg/HL and 13.90 g respectively. Protein, ash, fat, carbohydrate and crude fiber content of rice were found to be 7.12%, 0.81%, 0.43%, 78.07% and 0.71% respectively. Similarly, Total solids, TSS, total sugar, reducing sugar and ash content of jaggery were found to be 87.04%, 85.73%, 17.36% and 3.43% respectively. The mean sensory scores for color, flavor, mouthfeel, texture and overall acceptability for samples A were found to be 8.125±0.641, 7.875±0.835, 7.875±0.641, 8.25±0.707 and 8.125±0.641 respectively, and that for sample B was found to be 7±0.756, 7.625±0.916, 7.25±1.165, 6.75±1.669 and 7.625±0.916 respectively. Sample A was significantly superior in terms of texture ($p=0.009$) and color ($p=0.038$). Proximate analysis of sample showed that moisture, protein, fat, ash and crude fiber content to be 9.4%, 4.1%, 3%, 0.5% and 0.2% respectively. PV increased from 1.27 meq/kg to 6.11 meq/kg whereas AV increased from 0.21 mg KOH/g to 0.30 mg KOH/g during 60 days storage.

Contents

Approval Letter .... **iii**

Acknowledgements .... **iv**

Abstract .... **v**

Contents .... **vi**

List of tables .... **x**

List of figures .... **xi**

List of plates .... **xii**

List of abbreviation .... **xiii**

1. Introduction **1-3**

1.1 General introduction 1

1.2 Statement of the problem 2

1.3 Objectives 2

1.3.1 General objective 2

1.3.2 Specific objectives 3

1.4 Significance of work 3

1.5 Limitations of work 3

***2*. Literature review** **4-21**

2.1 *Kasar* 4

2.2 Ingredients used for preparation of *kasar* 4

2.2.1 Rice 4

2.2.1.1 Production and consumption of rice 6

2.2.1.2 Chemical composition of rice 7

2.2.1.3 Rice protein 8

2.2.1.4 Determination of crude protein 9
2.2.1.5 Minerals in rice 10
2.2.1.6 Uses of rice 10
2.2.1.7 Nutritional benefits of rice 11
2.2.1.8 Variety of rice 12
2.2.1.9 Variety of rice for the preparation of *kasar* 13
2.2.2 Rice flour 13
2.2.2.1 Different products from rice flour 15
2.2.2.2 Some Nepali traditional foods from rice 16
2.2.2.3 Effect of cooking on nutritional value 17
2.2.3 Jaggery 19
2.2.3.1 Chemical composition of jaggery 20
2.2.3.2 Health benefits of jaggery 21
3. Materials and methods 22-28
3.1 Materials 22
3.1.1 Rice 22
3.1.2 Jaggery 22
3.1.3 Butter 22
3.1.4 Packaging material 22
3.2 Method 22
3.2.1 Preparation of rice flour 22
3.2.2 Preparation of jaggery syrup 22
3.2.3 Method of preparation of *kasar* 23
3.2.4 Making of *kasar* ball 24
3.2.4.1 Analytical procedures 24

3.2.4.1.1 Determination of l/b ratio of rice 24
3.2.5 Determination of bulk density 24
3.2.6 Determination of thousand kernel weight 25
3.3 Chemical analysis 25
3.3.1 Moisture content 25
3.3.2 Crude fat 25
3.3.3 Crude protein 25
3.3.4 Crude fibre 26
3.3.5 Total ash 26
3.3.6 Reducing sugar determination 26
3.3.7 Total sugar determination 26
3.3.8 Determination of iron 26
3.3.9 Determination of calcium 26
3.3.10 Carbohydrate determination 27
3.3.11 Determination of Acid Value 27
3.3.12 Determination of Peroxide Value 27
3.4 Sensory analysis 27
3.5 Data analysis 27
4. Results and discussions 29-36
4.1 Determination of physical properties of rice 29
4.2 Determination of chemical properties of rice 30
4.3 Determination of chemical composition of jaggery 31
4.4 Sensory analysis of *kasar* 32
4.5 Proximate analysis of *kasar* 33
4.6 Storage stability of *kasar* 34

4.6.1 Changes in Peroxide Value of *kasar* 34

4.6.2 Change in Acid Value of *kasar* 35

4.6.3 Cost estimation of *kasar* 36

5. Conclusions and recommendations... 37

5.1 Conclusions 37

5.2 Recommendation 37

6. Summary 38

References...39-42

Appendices 43-47

Photo gallery 48

List of tables

Table No.	Title	Page No.
2.1	Nutrients content per 100g of polished rice	7
2.2	Average composition of rice (% dry weight basis)	7
2.3	Rice protein fraction	8
2.4	Level of essential amino acids of milled rice	10
2.5	Proximate composition of rice flour	15
2.6	Chemical composition of jaggery	20
4.1	The physical properties of rice	29
4.2	The chemical properties of rice	30
4.3	The chemical properties of jaggery	32
4.4	Proximate of *kasar*	33
4.5	Cost of raw materials of *kasar*	36
C.1	one-way ANOVA for *kasar* type (blocking panelist) for color	45
C.2	one-way ANOVA for *kasar* type (blocking panelist) for flavor	45
C.3	one-way ANOVA for *kasar* type (blocking panelist) for mouthfeel	46
C.4	one-way ANOVA for *kasar* type (blocking panelist) for texture	46
C.5	one-way ANOVA for *kasar* type (blocking panelist) for overall acceptability	47

List of figures

Figure No.	Figures	Page No.
3.1	*kasar* preparation according to first process	23
3.2	*kasar* preparation according to second process	24
4.1	Sensory score of *kasar*	33
4.2	Changes in Peroxide value with respect to number of days of storage	34
4.3	Changes in Acid Value with respect to number of days of storage	35

List of plates

Plate No.	Title	Page No.
P.1	student performing the lab test	48
P.2	*Kasar*, the product	48
P.3	roasted rice Flour	48

List of abbreviation

Abbreviation	Full form
PEM	Protein Energy Malnutrition
FAO	Food and Agriculture organization
TD	True Digestibility
NPU	Net Protein Utilization
KN	Kilo Newton
Lb	Pound
kJ	Kilo Joule
HMG	His majesty Government
ANOVA	Analysis of Variance
NFC	Nepal Food Corporation
AOAC	Association of Analytical Chemist
WTO	World Trade Organization
GI	Glycemic Index
BV	Biological Value
AV	Acid Value
PV	Peroxide Value
PP	Polypropylene

Part I

Introduction

1.1 General introduction

Humans require food to survive. Food is necessary for life to exist. People have various dietary preferences and eating habits depending on their religion, ethnicity, geography, climate, season, education, economic status, and rural or urban location. (K.C., 2007).

Traditional foods are foods that originated locally in a region, with regard to the country, region, district or sub-district, and religions, castes, and so on. In terms of food products, vegetables, fruit trees and yield products, carbohydrates, vitamins, and minerals, the definition comprises all indigenous food plants found in a given location. Indigenous foods are not cultivated in any formal way and are considered food for children and the destitute in rural areas. (IPGRI, 1992).

In order that indigenous food can be promoted in a more sustainable way, it is imperative that the knowledge of traditional food plans is encouraged (Ohiokpehai and Ramoswee, 1999). *Gundruk, kinema, sinki, kasar*, and other traditional foods lack written documentation regarding their preparation, processing, and quality control procedures. Food preparation methods are taught through a "doing and learning" methodology, which is passed down from mother to daughter. They use their senses to check for quality, such as gazing, smelling, feeling, and chewing (for taste). In such foods, there is no established scientific measuring system. However, even then, it is appraised by well-versed professionals in that field who use their sense organs. (K.C., 2007).

Nepal is a country with a diverse culture, tribes, religions, and ethnic groups. Since time immemorial, they have had their unique culinary customs influenced by their predecessors. They have their own traditional food preparation and preservation methods that they have passed down from generation to generation. With a few exceptions, Nepalese traditional foods and food products originated there. Indigenous food products refer to these traditional foods and foodstuffs. Some are nutritional, while others are used as an appetizer or have therapeutic benefit. Some dishes, such as *kasar* for the *Brahmin and Chhetri* communitys' *kasar,* are associated with specific events and persons. It is also required in the ceremonial process and in the worship of God. (Personnel communication, 2011).

Kasar is the product prepared from cooked jaggery indigenous to *Brahmin and Chhetri* community of Nepal. It is in especially made in the shape of ball. It is artistic bread. It is also necessary item to worship during chat puja in Madehsi community (Shrestha, 2004).

Normally, it is prepared in weddings and *bratabhand. nhacha mari* (made by rice flour) (Shrestha, 2004).

Kasar is prepared from rice flour and jaggery. Sometimes, other ingredients are also used. Since it is prepared from rice and jaggery enriching with minerals and vitamins, it can be made more nutritious, which will certainly help to minimize PEM (protein energy malnutrition) from Nepal (Personal communication, 2011).

1.2 Statement of the problem

Every country has its own indigenous food products which gives it cultural identity. In the context of Nepal, there are many indigenous foods like *kasar, jand, gundruk, sel roti, sinki,* etc., which are concerned with specific ethnic group and place.

Kasar is prepared over generations, and production method is passed down from generation to generation with little or no modification due to verbal communication. The biggest issue with promotion is a lack of research and development. The product's quality is a crucial concern for quality assurance. *Kasar* is now prepared at the household level for direct consumption on special occasions. It is still not commercialized. It might be commercialized with a little technical aid and attention to hygiene and quality, producing jobs and revenue in rural regions.

1.3 Objectives

1.3.1 General objective

The general objective of the work is to prepare and evaluate the quality of *kasar*.

1.3.2 Specific objectives

1. To collect the information about *kasar* from different district of Nepal.
2. To perform physical and chemical analysis of rice, and jaggery used.
3. To prepare *kasar*.
4. To perform sensory evaluation of *kasar*.
5. To perform analysis of best *kasar*.
6. To study the shelf life of *Kasar*

1.4 Significance of the work

Nepal, being a member of WTO has to register her indigenous products such as *kasa*r. The first step to claim the "Intellectual Property Right" of *kasar* requires its scientific study. The traditional method of *kasar* preparation technology should be commercialized and a proper packaging system should be introduced.

Present work helps to introduce *kasar* to the people as an important indigenous food. It is a little step to promote the single indigenous food. Several such foods which are only limited to the house hold level can be promoted. The data and results obtained by this work can be used by those who will work related to it in future.

1.5 Limitations of the work

1. Only one variety of rice was considered for making *kasar*.
2. Shelf life of *kasar* was studied for 2 months only due to time limit.
3. Public survey of *kasar* is limited to the certain group of people.

Part II

Literature review

2.1 *Kasar*

Kasar has been prepared since antiquity. There is no any exact evidence of its introduction in Nepalese society *Kasar* is a popular rice-based, sweet, hard ball. Historically *kasars*, Nepalese indigenous food, were used by the people to express their happiness and grace on different occasions concerned with special cultural occasions like marriage and bratabandha. *Kasar* has cultural importance among ethnic groups of Nepal. The preparation of *kasar* is an art of technology and the knowledge is transferred from one generation to another in those ethnic groups. Women prepare it and the man help them in pounding the soaked rice. *Kasar* is mostly prepared at home during special occasion. Since time immemorial *kasar* is known as a ceremonial food in Nepal. It marks the special occasion of the Nepalis such as marriage and bratabandha. (Personal Communication, 2022).

2.2 Ingredients used for preparation of *kasar*

The major ingredients used for its preparation are rice and jaggery.

2.2.1 Rice

Rice is the main crop of Nepal as well as of the world. The main diet of the Nepalese is also rice. Fifty-five percent of the cultivated land of Nepal is covered with rice. Rice is cultivated in the diverse climatic ranges of Nepal at differing altitudes, topography and climate. More than half of the human population depends on rice for food. Ninety percent of the rice grown in the world is produced and consumed in Asia. There are different views about the origin of rice by different scientists. As early as 1930 Vavilov pointed out that the origin of the present rice is in the Southeast Himalayan region. Therefore, according to him the origin place of rice is in the south-East Asia, India, China and Indochina where different types of rice are found. If we consider his views the Himalayan range is also in Nepal. Rice belongs to gramineae family and *Oryza* genus. There are 25 species of rice, out of 25 species 23 are wild type and two species are cultivated. The rice of Asia, Europe and America is *Oryza glaberrima*. Rice cultivation has been done since the beginning of the civilization, so there are thousands of varieties in the world (Mallick, 1981).

Rice (genus Oryza) is a plant of the grass family, which is a dietary staple of more than half of the world's human population. Rice cultivation is well suited to countries with low labour costs and high rainfall, as it is very labor intensive to cultivate and requires plenty of water for irrigation. However, it can be grown practically anywhere, even on steep hillsides. Rice is the world's third largest crop, behind maize (corn) and wheat. Although its species are native to South Asia and certain parts of Africa, centuries of trade and exportation has made it common place in many cultures. The modern English word 'rice' originates from ancient Greek word 'arizi' which in turn was borrowed from the Tamil word of the same pronunciation, strongly indicating trade relationship between ancient Greeks and Tamils (Pokhrel, 2008).

Rice has been one of the most commonly used grain products since ancient times. It is the stable food of the greatest number of people. Historian can’t be accurate about the first appearance of rice because rice cultivation is older than recorded events. Though a lack of historical records prevents accurate determination, botanical evidence suggests strongly that rice originated in southeast continental Asia. Rice is grown in all tropical countries in eastern and southern Asia including the larger nearby islands, especially Japan. The principal rice producing countries are China, India, Pakistan, Japan and Indonesia, Thailand, Indochina, Myanmar and Philippines also produce large quantities of rice. Many varieties of rice are produced throughout the world. It has been estimated that there are approximately 7,000 known varieties of rice (Johnson and Peterson, 1974)

There are only two cultivated species *Oryza glaberimma* and *Oryza sativa*. *Oryza glaberimma* is confined to West Africa but is being replaced by *Oryza sativa*. Morphologically there are only small differences between these species. Origin of *Oryza sativa* is South-East Asia, particularly India and Indo-China (Grist, 1975).

Rice cultivation is considered to have begun simultaneously in many countries over 6,500 years ago. Two rice varieties were domesticated: Asian rice (*Oryza sativa*) and

African rice (*Oryza glaberrima).* It is believed that common wild rice, *Oryza rufipogon* was the wild ancestor of Asian rice. *O. sativa* appears to have originated around the foothills of the Himalayas, with *O. sativa indica* on the Indian side and *O. sativa japonica* on the Chinese side. African rice has been cultivated for 3,500 years (Pokhrel, 2008).

Taxonomic classification is given below.

Kingdom: Plantae

Subkingdom: Viridiplantae

Infrakingdom: Streptophyta

Superdivision: Embryophyta

Division: Tracheophyta

Subdivision: Spermatophytina

Class: Magnoliopsida

Superorder: Lilianae

Order: Poales

Family: Poaceae

Genus: Oryza L.

Species: Oryza sativa L.

Source: ITIS (2022)

2.2.1.1 Production and consumption of rice

In 2020/21 509,286 thousand metric tons of rice was produced. China was major rice producer accounting for 146,730 thousand metric tons of rice and Nepal produced 3,736 thousand metric tons of rice. Similarly, in 2020/21 503,554 thousand metric tons of rice were consumed, China being the major consumer consuming 145,230 thousand metric tons of rice. Nepal consumed 4,971 thousand metric tons of rice. (USDA, 2022)

2.2.1.2 Chemical composition of rice

The composition of rice differs with the variety, the nature of the soil, environmental conditions and the fertilizers applied. The fat content of rice is low and most of it is removed in the process of milling and is contained in the bran (Grist, 1975). The average composition of both husked and polished rice is given in Table 2.1

Table 2.1 Nutrient content per 100g polished rice

Parameters	**Amount**
Calorific value	1461 KJ (344 KCal)
Water	12.9 g
Protein	6.8 g
Lipids	0.6 g
Carbohydrates	77.8 g
Fiber	1.4 g
Minerals	0.5 g

(Source: Matthias, 1999)

Table 2.2 Average composition of rice (% db)

	Husked %	**Milled(Polished) %**
Carbohydrate	87.67	90.79
Protein	8.67	8.15
Fat	2.45	0.37
Crude Fiber	0.88	0.16
Ash	1.22	0.36

(Source: Matthias, 1999)

The nutrient content of the polished rice is given in Table 2.2 The total fat content of milled rice remained constant in either ordinary or hermetically storage under a wide range of moisture and temperature conditions, but its gross composition nevertheless changed with an increase in free fatty acid and decrease in natural fats and phospholipids (Pillaiyar, 1998).

2.2.1.3 Rice protein

The major constituent of milled rice is starch, and it is most concentrated in the endosperm portion of the kernel. Protein is the second most abundant constituent of rice grain and is unique among the cereal protein because it contains at least 80% glutelin (alkali-soluble protein). Glutelin has the similar amino acid composition to milled rice protein, probably because it is the major protein fraction. The protein content of rice of any variety can vary considerably even when grown at same location. The effect of differences in protein contents of milled rice on their nutritive quality shows that protein quality tended to decrease as protein contents increased (Whitaker and Tannenbaum, 1977). The rice protein fractions are given below in Table 2.3.

Table 2.3 Rice protein fraction

Proteins / Glycoproteins	Amount of total protein
Soluble fractions	
Albumines (water soluble)	10.8 %
Globulines (salt-soluble)	9.7 %
Prolamines (70%-ethanol soluble)	2.2 %
Insoluble fraction	
Glutelins	77.3 %

(Source: Matthias, 1999)

Protein of rice occurs mainly in protein bodies of the endosperm. Whole milled rice protein has almost the same composition as the protein bodies. About 80 % of the protein in milled rice is the alkali soluble protein, glutelin. Among the cereal grains, rice is unique since it contains high levels of glutelins and low prolamine contents (5 %). The lysine content of the rice protein is relatively high (3.5-4.0 %) due to the low level of prolamine. The latter is a nutritionally poor-quality fraction (Anglemier and Montogomery, 1976).

The main protein is *Oryzenin.* The protein content of milled rice is low in comparison with other cereals, although the whole rice grain contains about the same quantity as wheat. The protein is rich in arginine but like in other cereals poor in lysine and threonine (Grist, 1975).

2.2.1.4 Determination of crude protein

For the determination of nitrogen, first the protein content of materials may be calculated. Proteins are complex organic substances consisting of chains of amino acids. They are the major constituents of all living cells, both plant and animal. The nitrogen content of different proteins is nearly alike and is approximately 16 %, hence multiplying the nitrogen estimated by the factor 6.25 yields the amount of protein. In certain cases as, for example, casein, a higher factor, namely 6.38 is used for this conversion and more nearly represents the true proportion of nitrogen in this cases. The estimation of nitrogen is generally done by a modified Kjeldahl digestion method. This digestion should be done only in a hood with a good draught. This method depends upon the decomposition of organic nitrogen compounds by boiling with sulphuric acid. The carbon and hydrogen of the organic material are oxidized to carbon dioxide and water. A part of the sulphuric acid is simultaneously reduced to sulphur dioxide, which in turn reduces the nitrogenous material to ammonia. The ammonia combines with the sulphuric acid and remains as ammonium sulphate, a substance with a high boiling point. The ammonia is subsequently liberated by the addition of sodium hydroxide; is distilled into a known amount of standard acid and the excess acid is estimated by titration with standard alkali (Jaccobs, 1958). The level of essential amino acids of milled rice is given below in Table 2.4.

Table 2.4 Level of essential amino acids of milled rice

Essential amino acids	Protein %
Isoleucine	4.13
Leucine	8.24
Lysine	3.80
Methionine	3.37
Methionine+ Cystine	4.97
Phenylalanine	6.02
Threonine	4.34
Tryptophan	1.21
Valine	7.21

(Source: Whitaker and Tannenbaum, 1977)

2.2.1.5 Minerals in rice

The ash distribution in brown rice is not homogeneous: 51 % is found in bran, 10 % in germ, 11 % in polish and 28 % in milled rice. Rice also contains phytate, an inhibitor of mineral absorption (especially iron and zinc). The content of phytate is at a high level (120mg/ 100g) even in milled rice. So, although the populations average minerals intake was at a high level, there is much disease due to minerals deficiency. (Liang, 2003).

2.2.1.6 Uses of rice

Rice flour has historically been used in baby foods and extruded rice crisp. In recent years, more rice flour is being used in cereals, crackers, chips, snacks, and coating applications to provide different textures. Textures can be altered dramatically depending on the type of flour used. It is widely used in the preparation of sauces and gravies for the preparation of Soya rice to make fried rice, frozen cooked rice (Sagefoods, 2005).

Rice is also used for rice milk, rice puddings, rice vinegar, rice wine etc **(**Tripsofallsorts, 2005).

2.2.1.7 Nutritional benefits of rice

Rice is an excellent food to help in keeping our body healthy. Rice has the following nutritional benefits:

a) Excellent source of carbohydrate and energy

Good nutrition is vital to everyday performance, and eating more carbohydrate rich foods means having more energy. Rice is an excellent source of carbohydrates. Carbohydrates provide energy to fuel working muscles and feed the brain to enhance concentration. Carbohydrates are not normally converted to body fat, as they are the body's preferred source of energy. Carbohydrates are broken down to glucose, most of which is used as energy for exercise and as essential fuel for the brain (Kondidin, 2005).

Crude fiber means the combustible residue that is left after the other carbohydrates and the proteins have been removed by successive treatments with boiling acid and alkali. This residue is largely cellulose and consists of carbohydrates not assimilable by humans (AOAC, 2005).

b) Low in fat, salt and has no cholesterol

The Australian Dietary Guidelines recommend eating plenty of breads and cereal. Rice is an excellent food to include in a balanced diet. It is low in total fat and saturated fat, is cholesterol free, and contains negligible amounts of sodium.. Rice is also cholesterol free, therefore it is an excellent food to include in a cholesterol lowering diet. Brown rice contains a small amount of rice bran oil (Kondidin, 2005).

The free lipid content which consists essentially of neutral fats (triglycerides) and free fatty acids can be conveniently determined in foods by extracting the dried and ground material with a light petroleum ether in a continuous extraction apparatus. The Soxhlet type gives intermittent extraction with excess of fresh condensed solvent. The efficiency of the method relies on sample pretreatment and choice of solvent (Egan *et al*, 1981).

In contradiction to the extraction process in which multiple portion of an extracting immiscible solvent are used, there is the continuous extraction process. In these procedures, the apparatus is designed so that a fresh portion of solvent comes in contact with the material to be extracted over a relatively long period of time. There are many forms of this type of the apparatus. One of the most commonly used is the Soxhlet type of continuous extractor. This process is continuous until the extraction is complete, varying at times from 8 to 24 hours (Jacobs, 1958).

c) Gluten free

Some people are unable to tolerate the proteins found in wheat, barley, rye and oats. People choose foods that are gluten free. All rice is gluten free, making rice the essential choice for people with gluten free dietary requirements (Kondidin, 2005).

d) Contains no additives or preservatives

Rice contains no additives or preservatives, making it an excellent inclusion in a healthy and balanced diet. Rice also contains resistant starch, which is the starch that reaches the bowel undigested. This encourages the growth of beneficial bacteria, keeping the bowel healthy (Kondidin, 2005)

e) Low glycemic Index

Worldwide research has shown that different carbohydrate foods have dramatically different effects on blood sugar levels. The glycemic index was developed as a means of ranking foods based on their immediate effect on blood sugar levels. Carbohydrates which break down quickly during digestion have the highest GI factors and carbohydrates which break down slowly, have low GI factors. Health benefits of low GI foods result in lower insulin levels which makes fat easier to burn and less likely to be stored, and reduce appetite and help to sustain endurance exercise for longer (Kondidin, 2005).

2.2.1.8 Variety of rice

Rice is categorized into long, medium or short grain. The amount of amylose, a starch present in rice will determine how sticky and fluffy the rice grains will turn out after being cooked. Long grain rice is 4 to 5 times as long as the width. It is slender and whitish. When long grain rice is cooked, grains remain separate and fluffy. It is a good choice for main dish, side dish or salad recipes. Medium grain rice means grain fits just in between the long and short grains. It is about 2 or 3 times as long as the width. Short grain rice is almost round and plump and it has the highest amylose content among the 3 types of grains (Tripsofallsorts, 2005).

The different varieties of rice differ greatly in their composition of starch (amylose and amylopection). All of these various types and forms of flours provide different functionality. Long grain rice flour (22% amylose) commonly known as standard rice flour used in coating applications and many of the clear coatings currently found on French fries. Medium grain rice flour (18% amylose) can be used in the same applications as long grain flour, but provides a lighter texture and a little more expansion when puffed. Waxy rice flour (0% amylose, 100% amylopectin) can be used in many of the same applications as long grain flour, but provides an even lighter texture and much more expansion when puffed (Sagefoods, 2004).

2.2.1.9 Variety of rice for the preparation of *kasar*

Kanchhi mansuli is the variety of rice used for the *kasar* preparation. The coarse variety of rice is also used for its preparation.

New rice is preferred to obtain the good quality of *kasar*. The new rice gives soft and well puffed dough for the preparation of good quality of *kasar* (Personal communication, 2005).

2.2.2 Rice flour

Like wheat or rye, white or brown rice can easily be ground into flour after hulling. Rice flour is primarily made from polished broken rice and is therefore usually whiter than wheat or rye flour. In addition, it is usually ground more finely. Rice flour is made by grinding whole grains or broken rice. There are two sorts of rice flour for human consumption which are distinguished by the type of rice and its starch components. The first type is made from glassy, hard grains, the type of rice most often cooked at home and the second, from glutinous or waxy rice. Because of its great ability to swell, the glutinous rice flour lends a slightly rubbery texture to dough. It is used for thickening white sauces and in desserts. Products made from glutinous rice flour are well suited to freezing because, unlike many other starches, it does not separate and lose moisture when thawing. There is a major difference between rice flour and most other grain flours. Rice flour cannot be used in baking. The reason for this has to do with its chemical composition. Although rice flour contains a great deal of starch, it does not contain the protein gluten, which is an important structural component in dough. The protein contained in rice has a different composition than wheat protein. In dough made with wheat flour, the gluten, a structural protein composed of gliadin and glutenin, runs through the dough in fine elastic strands. The gluten "traps" the expanding moisture/steam and enables the dough to rise. The protein in rice flour cannot build this net-like framework. Baked goods made from rice flour therefore do not rise and produce very few pores in the finished product. The very fine-grained rice flour, ground mainly from broken rice, is also used in special diets. Rice flour is easily digested by people with celiac disease (a gluten allergy) and is used in baby foods. It has been used as a cosmetic powder since ancient times. Rice flour from whole and broken rice forms the basis for rice noodles and thin rice paper. Rice paper and rice noodle leaves are ideal wrappings for fillings of all sorts. Egg rolls, for example, are often wrapped in rice paper. Snow white and powdery fine, rice flour provides the basis for many foods including puddings, rice noodles and many snacks (Pokhrel, 2008).

Rice flour is finely granulated powder made by grinding and sifting a long grain variety of rice, unless otherwise specified, which is hard milled and electronically sorted to insure whiteness. The proximate composition of rice flour is given below in Table 2.5.

Table 2.5 Proximate composition of rice flour

Chemical composition	Range	Average
Protein	6.0-9.0%	7.5%
Fat	0.4-1.0%	0.8%
Crude Fiber	0.3-1.0%	0.7%
Ash	0.6-0.8%	0.7%
Moisture	8.5%-13.0%	11.0%
Carbohydrate	75.8-84.2%	80%

(Source: Pokhrel, 2008)

2.2.2.1 Different products from rice flour

Rice flour does not contain gluten and therefore its dough cannot retain gases during baking as wheat flour does. Therefore, rice flour is widely used in making baby foods, breakfast cereals, unbaked biscuits, snack foods, pancakes, and waffles. For example, a composite baking flour, made by adding 10 percent rice flour to wheat flour, is used to make pastry products in Italy (Grist, 1986).

Rice-flour products are exemplified by the following foods: *yuan zi* (or *tong yuan*) is a popular food in China. It is made from glutinous rice flour and water by adding sweet or savory fillings to the rice dough. The quality of *yuan zi* preparation depends on the amylopectin content, the flour particle size, and the recipe for the fillings. (The higher the amylopectin content, the softer and stickier the rice flour becomes when the same amount of water is added.) *Yuan zi* is fried with vegetable oil or thoroughly cooked in boiling water and served with sugar or other condiments.

Rice bread is a good substitute for other gluten-containing cereal flour, as some people are allergic to these flours. The medium-and short-grain rice varieties are preferable to the long-grain type for making rice bread. Formulation is important in making rice bread by adjusting the levels of sucrose, yeast, water, nonfat dry milk, and other additives (Luh and Bor, 1991).

2.2.2.2 Some Nepali traditional foods from rice

a) *Bhakka*

Bhakka is indigenous food of Nepal. It is prepared from rice flour. Mainly it is consumed by the low class family in the market and also consumed specially by Morangia Tharu. They serve it as breakfast, lunch, dinner as stable food. It is hot served with Chutney, Salt, Milk, tea, vegetable curry, tomato and chili sauce, meat, fish, salad etc. it may also be stored for two to three days and hot served after re-steaming. It is generally prepared and sold in during winter season, generally Mangsir 1st to Falgun 1st. they specially prepared for guests during these days. The weight of *Bhakka* for selling was found to be 25gm to 50gm (Pokhrel, 2008).

b) *Selroti*

It is a doughnut-shaped, deep fried rice confection indigenous to Nepal. Normally, it is prepared in festive occasions and rituals like *Tihar, Pooja, Bratavanda, and Kajkriya*. But, these days it is available almost all the time at hat-bazaars (local market) and cities. The main ingredients used for the preparation of *selroti* are rice flour, sugar, ghee and refined oil. The process of manufacturing of and the ingredients used depends on the availability of raw materials and differ from place to place. In some places people use ripe banana, *dahi and* cream as an improver. Finely ground rice flour, sugar and ghee are mixed properly and fried in ghee or *vanaspati* (hydrogenated vegetable oil) (Pradhan, 2005).

c) *Kasaar*

Kasaar is an oval- or a ball-shaped confection made from jaggery (25-30% by mass) and roasted rice (70-75% by mass). This food is especially prepared in the Brahmin and Chettry communities and is considered an indispensable item in wedding ceremony and other similar ceremonies. Since, the product is an intermediate moisture food; it has a shelf life of several months. Each ball weighs about 40-50g. Depending on the enormousness of the ceremony, some 10-30 kg of rice may be used for *kasaar* preparation (Kharel *et.al.*, 2010).

d) *Chuira*

Chuira or beaten rice flakes is a very common food item in Nepal. It is precooked, has crispy texture and is in a ready to serve form. It is eaten as a snack or as a full meal with *achar* (pickle), chutney,meat, eggs, vegetables, beans, etc. It is famous in all communities especially in Newar, Brahmin,, Chhetri, rajbanshi, choudhary, etc. Special course variety of rice is suitable for *chuira* production.Researchers shows that *chuira* making incurs loss of minerals like calcium and iron (Kharel *et.al.*, 2010).

e) *Bhuja*

Bhuja or *murai* is a puffed rice product. It is mainly consumed snack in the terai belt of Nepal. The term *murai* is derived from the term *murra*, which mean 'puffed'. The nutritional value is similar to thet of rice. It is mainly used by the Tharu and Chaudhary ethinic groups of Nepal. For them it is very important food items in marriage ceremony, festivals and other occasions. *Murai* is also used for the preparation of *chatpate*, a peppery snack sold by vendors in local markets. The food goes well with all types of dishes. It is generally prepared from long variety rice *Oryzae indica* (Kharel *et.al.*, 2010).

2.2.2.3 Effect of cooking on nutritional value

Cooking reduces the mean true digestibility (TD) of protein in growing rats from 99.7 to 88.6% for milled rice of a waxy variety IR 29 (8.1% crude protein) and two non-waxy varieties IR32 (7.5% protein) and IR480-5-9 (11.2% protein) (Aykroyd *et.al.*, 1940). However, a corresponding increase in biological value (BV) from 67.7% to 78.2% was noted, which gave slightly higher net protein utilization (NPU) for two of the three rices as cooked rice (Clarke, 1982). The nutritional importance of not washing rice before cooking is now clearly evident. It is most desirable to distribute sanitary cleaned whole rice to households. The practice of cooking rice in excess water which results in loss of nutrients in the gruel has arisen out of necessity. If the gruel is left behind, the cooked rice is pasty mass that is difficult to digest. The solid loss in excess cooking water is more when the rice is cooked in a vessel directly over fire. The ebullition of the boiling water makes the grains hit against each other, resulting in leaching out of starch into the cooking water and formation of thick sticky gruel. This difficult is not experienced during the cooking of the parboiled rice, because its grain is hard and leaching of starch into the cooking water is usually very little. Steam cooking or double pot cooking with minimum water will reduce the above difficulties and should therefore be recommended. Educational efforts are required to introduce improved household practices in rice washing and cooking (Pillaiyar, 1988).

a) Steam cooking

Cooking is the application of heat to food the purpose of making it more digestible, softer to eat, more palatable and to change its appearance to cook food it must be introduces into food (Metcalf and Lund, 1985).

Heat applied in cooking destroys bacteria dangerous to man such as those causing dysentery, salmonellosis, and streptococcus food infection. A temperature of 60°C (140°F) over 30 minutes or more minutes kills most pathogenic germs. However, some spores and the toxin produced by staphylococcus aurous a common cause of food poisoning are not destroyed by the usual cooking temperature. The time necessary for heat to penetrate into food material partly determines the method of cooking and the best cooking and the best cooking temperature (Alford, *et.al*., 1998).

Starchy foods which contain much water are usually cooked at relatively high temperatures. The pH or hydrogen concentration is also important in starch cooking. As starches are heated their granules also absorb water and become firm gelatinize. Starch mixture with both high and low pH values gelatinize more rapidly than those with intermediate pH values. Those same high or low pH value mixtures also breakdown starch more rapidly by destroying the starch cell (Metcalf and Lund, 1985).

Cooking time-temperature and equipment are selected to maximize flavor, develop appetizing appearance and retain as much as possible of the odor, nutrients, vitamins and water in food materials. The selection of a cooking method often represents a compromise. Heat is transferred to food from heat sources by three principal methods, conduction, convection and radiation. Convection heating refers to heating which is brought about by movement or circulation of hot liquid or gases and called moist heating. Usually to high flesh foods are cooked in steam or liquid the moisture and heat together serving the connective tissue (Metcalf and Lund, 1985).

In the steaming, the steam surrounds food and as it changes from steam to water, gives up its heat to the food by means of conduction. The time require to cook food is a function of temperature, specific heat and of the thermal conductivity of the food. Foods cooked under pressure cook faster than foods cooked at atmospheric pressure, why? As pressure increases so too does temperature. Steam under 34.5kN/m2 (51lb/in^2) of pressure has a temperature not of 100°C (212°F) but 109.5°C (228°F) and contains six times more heat than boiling water (Metcalf and Lund, 1985).

At sea level water boils at 100°C (212°F) to change water at this temperature to steam it is necessary to add 2253 kj to each kilogram of water. This amount of heat or energy is known as specific latent heat of steam: it is latent which in the steam ready to be released when the steam condenses on food or in a cooking vessel, changing back into water, the same amount of heat energy -2253 kJ/kg is given off and may be transferred to food present. The principle of physics involved is that a quantity of energy is given out or taken in whenever a substance changes its state although there are no temperature changes involved. This latent heat helps to account for the relatively fast cooking of steam. Cooking by steam can be accomplished by equipment in which live steam surrounds the food material. It can be fee venting, the steam escaping into the atmosphere. In such a case the steam is called atmospheric pressure (Alford, *et.al*., 1998).

2.2.3 Jaggery

Jaggery is the sugarcane based traditional sweetener, which is produced in addition to the sugar (Thakur, 1999). These traditionally sweetener are the natural mixture of sugar and molasses. If pure clarified sugarcane juice is boiled, what is left as solid is jaggery. Jaggery is available in market in three forms namely solid jaggery, liquid jaggery and granular jaggery (Mungare *et al*., 1999).

Sugarcane juice is an opaque liquid and varies in colour from gray dark green to light yellow depending upon the colour of the cane. In addition to the various nutritional constituents it also contains mud, wax and various other soluble and insoluble impurities.

To maintain proper quality in jaggery, all the soluble and insoluble undesirable fractions should be removed (Rao *et al*., 2006).

2.2.3.1 Chemical composition of jaggery

Jaggery composition may vary according to cane variety, geographical location etc. The principal constituents of jaggery are sugars, salts, organic acids, fat and other organic non-sugars such as proteins. The chemical composition of jaggery is shown in Table 2.9.

Table 2.6 Chemical composition of 100 g jaggery

Carbohydrates	**mg**	**Vitamins**	**mg**
Sucrose	72-78	Provitamin	2
Fructose	1.5-7	Vitamin A	3.8
Glucose	1.5-7	Vitamin B1	0.01
Minerals	**mg**	Vitamin B2	0.06
Calcium	40-100	Vitamin B5	0.01
Magnesium	70-90	Vitamin B6	0.01
Phosphorous	20-90	Vitamin C	7
Sodium	19-30	Vitamin D2	6.5
Iron	10-13	Vitamin E	111.3
Manganese	0.2-0.5	Vitamin PP	7
Zinc	0.2-0.4	Protein	280 mg
Chloride	0.5-3	Water	1.5-7g
Copper	0.1-0.9	Calories	213

(Source: Jaswant *et al*., 2013)

2.2.3.2 Health benefits of jaggery

Jaggery a particularly wholesome sugar, since it retains more mineral salts than refined sugar and it is made without chemical agents. Indian Ayurvedic medicine considers jaggery beneficial in treating throat and lung infections. It was found that in rats jaggery can prevent lung damage from particulate matter such as coal and silica dust. Jaggery is healthier than refined sugar, as it was not introduced into the blood as rapidly (Sahu and Saxena, 1994).

Part III

Materials and methods

3.1 Materials

3.1.1 Rice

Kanchi mansuli rice was bought from local market of Dharan.

3.1.2 Jaggery

Jaggery was bought from local market of Dharan.

3.1.3 Butter

Amul butter was brought from local market of Dharan.

3.1.4 Packaging material

Polypropylene (PP) packets were bought from local market of Dharan.

3.2 Method

3.2.1 Preparation of rice flour

Rice was taken. Stones, husks and paddy were separated from it. Then, two methods were used for kasar making. In first, clean rice was soaked in water for 1 hrs at 30°C. After soaking the water was drained completely for 15 minutes. The complete drained wet rice was ground into flour. Flour was then sieved through the sieve size of 500 micron to obtain desire sized flour. It was then roasted and taken for kasar preparation. In, second method, rice was roasted and it was grinded into coarse powder and taken for kasar making.

3.2.2 Preparation of jaggery syrup

The jaggery was heated at about 90°C for about 5 minutes with the addition of little of water. The froth and unwanted particles in the jaggary was separated with the help of muslin cloth.

3.2.3 Method of preparation of *kasar*

Rice was taken. Stones, husks and paddy were separated from it. Then, two methods were used for *kasar* making. In first, as shown in Fig. 3.1 clean rice was soaked in water for 1 h at $30^{\circ}C$. After soaking the water was drained completely. The complete drained wet rice was ground into flour. Flour was then sieved through the sieve of different size to obtain desire sized flour. It was then roasted and taken for *kasar* preparation. In, second method, rice was roasted and it was grinded into coarse powder and taken for *kasar* making. Sample prepared from first method was labeled sample A whereas sample prepared from second method, as shown in Fig. 3.2, was labeled sample B.

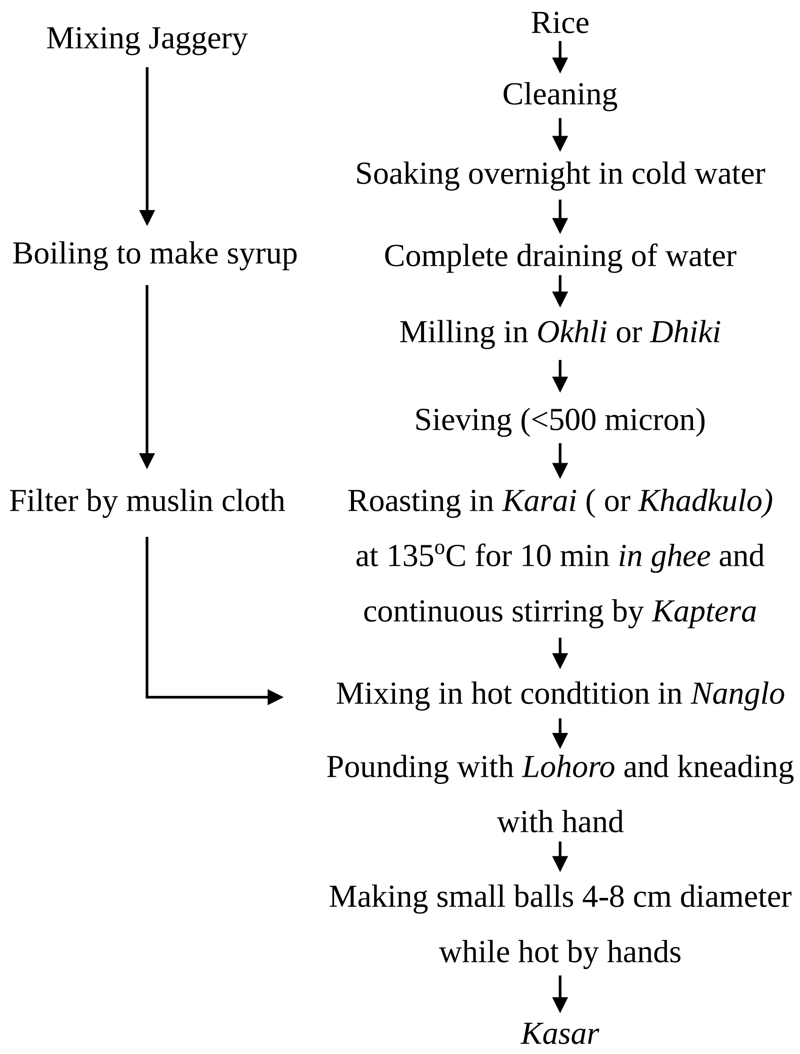

Fig 3.1 *kasar* preparation according to first process (A)

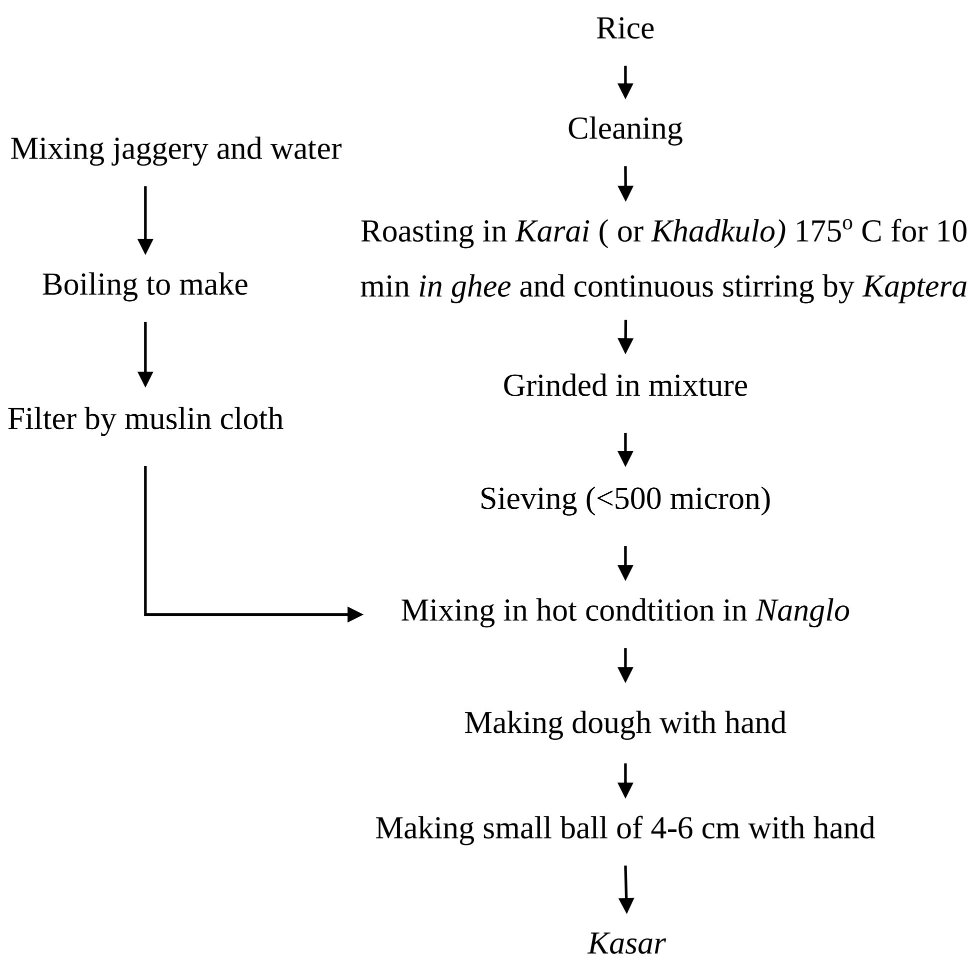

Fig 3.2 Preparation of *kasar* by second method (B)

3.2.4 Making of *kasar* ball

The roasted rice flour was shaped in ball form and jaggery was mixed to held flour together in ball size

3.2.4.1 Analytical procedures

3.2.4.1.1 Determination of l/b ratio of rice

The length and breadth were measured by using vernier caliper (Kent and Amos, 1983).

3.2.5 Determination of bulk density

Bulk density was determined by using Bushel weight tester (Seed Bureau, Chicago) and expressed in kg/HL. (Kent and Amos, 1983)

3.2.6 Determination of thousand kernel weight

The weight of 1000 kernel of rice was determined by electronic balance and was expressed in gram (Kent and Amos, 1983).

3.3 Chemical analysis

3.3.1 Moisture content

The moisture content was determined by using hot air oven method (K.C. and Rai, 2007).

$$\text{Moisture Content} = \frac{(W_{initial} - W_{final})}{W_{initial}} \times 100\%$$

Where, $W_{initial}$ = weight of sample before drying

W_{final} = weight of sample after drying

3.3.2 Crude fat

The fat content was determined by Soxhlet method (K.C. and Rai, 2007).

$$\text{Crude fat} = \frac{(W_2 - W_1)}{W} \times 100\%$$

Where, W_1 = weight of beaker

W_2 = weight of oil extracted + beaker

W = weight of sample

3.3.3 Crude protein

The crude protein was determined by using Kjeldahl's method (K.C. and Rai, 2007).

$$\text{Protein content (\%, wb)} = \frac{(sample - blank) \times N\ of\ HCl \times 14 \times 100 \times 100}{Aliquot\ (ml) \times wt.of\ sample\ (g) \times 1000}$$

3.3.4 Crude fibre

Crude fiber was determined by using chemical process, the sample was treated with boiling dilute sulphuric acid, boiling sodium hydroxide and then with alcohol, under standardized condition (K.C. and Rai, 2007).

Crude fiber (%, wb) = $\frac{(Residue - Ash)g \times (100 - F)}{sample\ (g)}$

3.3.5 Total ash

Ash content was determined according to K.C. and Rai (2007).

Ash content = $\frac{W_3 - W_1}{W_2 - W_1} \times 100\%$

Where, W_1 = weight of empty crucible

W_2 = weight of sample + crucible before ashing

W_3= weight of sample + crucible after ashing

3.3.6 Reducing sugar determination

Reducing sugar was determination by the method mentioned by (K.C. and Rai, 2007).

3.3.7 Total sugar determination

Total sugar was determined by the method mentioned by (K.C. and Rai, 2007).

3.3.8 Determination of iron

Iron content was determined by the method mentioned by (K.C. and Rai, 2007).

3.3.9 Determination of calcium

Calcium content was determined by the method mentioned by (K.C. and Rai, 2007).

3.3.10 Carbohydrate determination

By difference method.

Carbohydrate (%) = 100 - (protein + fat + ash + crude fiber)

3.3.11 Determination of Acid Value

Acid value was determined by the method mentioned by (K.C. and Rai, 2007).

$$\text{Acid value (as oleic acid)} = \frac{ml\ of\ alkali \times N\ of\ alkali \times 28.2}{weight\ of\ sample\ (g)}$$

3.3.12 Determination of Peroxide Value

Peroxide value was determined by the method mentioned by (K.C. and Rai, 2007)

$$\text{Peroxide Value} = \frac{N \times (V_s - V_b) \times 1000}{wt.of\ sample\ (g)}$$

Where, N= N of sod. Thiosulfate

V_s = sod. Thiosulfate consumed by sample in ml

V_b = sod. Thiosulfate consumed by blank in ml

3.4 Sensory analysis

Semi-trained panelists comprised of Central Campus of Technology teachers and students conducted the sensory analysis for overall quality. Mouthfeel, color, texture, flavor, and overall acceptability were the sensory evaluation parameters. The 9-Point Hedonic Scale was used to undertake sensory evaluations.

3.5 Data analysis

The data obtained in the course of sensory evaluation were analyzed by applying statistical tools - one-way ANOVA (blocking panelist) using the statistical software GenStat Release 7.1 (Discovery Edition 3 developed by VSN International Limited) which was developed by Lawes Agricultural Trust (1995) to statistical analysis and the scores given by the panellist 5% level of significance.

Part IV

Results and discussions

Length, breadth, L/B ratio, 1000 kernel weight and proximate composition of rice used for preparation of *kasar* was measured. Chemical composition of jaggery was determined. Sample A and B were prepared by using two methods. Sensory rating of two *kasar* were analyzed by semi-trained panelist. Best *kasar* was determined by carrying out one-way ANOVA on sensory scores blocking the effect of panelist. Finally, proximate composition of *kasar* was determined.

4.1 Determination of physical properties of rice

The physical properties of rice are given in Table 4.1.

Table 4.1 The physical properties of rice

Parameters	**Value**
Mean length (mm)	5.80
Mean breadth (mm)	2.15
L/B ratio	2.69
1000 kernel weight (gm)	13.90
Bulk density (kg/ HL)	93

Mean length and breadth of rice was found to be 5.80 mm and 2.15 mm. According to NFC 2062, the length and breadth of *Mansuli* should be in the range of 5-6mm and 2-2.2mm respectively. The value obtained fall in the range of standard value.

The mean L/B ratio was found to be 2.69 for *Kanchi Mansuli.* According to NFC, 2062 classification, the L/B ratio should be in the range of 2.5- 2.7 to be *Mansuli* variety.

According to FAO, 1972 size classification (1972), the observed variety of rice fall in medium variety. But according to FAMSD, 1977, the variety is of medium.

Size and shape are important parameters in grain marketing including milling, transportation and storage. Long grain varieties have higher chance of breakage during milling than short. Generally, it is assumed that higher the L/B ratio higher will be the loss in milling (Raut , 2006).

Thousand kernel weight of rice was found to be 13.90 g. The result obtained is in accordance to Shrestha, 1984 who has found the value to be 13 g. According to Ban, 1988, 1000 kernel weight of *Mansuli* was 11.7 gram, according to Limbu, 1987, 17.40gram.

Bulk density was found to be 93kg/ HL. According to FAMSD classification, *Kanchi Mansuli* falls in coarse variety.

4.2 Determination of chemical properties of rice

The proximate composition of rice as used for *kasar* preparation are tabulated in wet basis in Table 4.2.

Table 4.2 Chemical properties of rice

Parameters	**Value %**
Moisture content (wb)	12.83±0.35
Crude protein (db)	7.12±0.41
Total ash (db)	0.81±0.17
Fat (db)	0.43±0.15
Crude Fiber (db)	0.71±0.1
Carbohydrate (db)	78±0.30

*The values in the Table 4.2 are the mean of the triplicates ± standard deviation.

The moisture content of *Kanchi Mansuli* was found to be 12.83. The maximum limit for moisture content in rice is 14 % (NFC, 2062). The lower the moisture content, the better the storage stability of rice (Pillaiyar, 1981). The growth of microorganism gets retarded; thus, spoilage is minimized at low moisture. Fungi need oxygen for their respiration, and die or at least cease to grow in condition of low oxygen. Water activity ranges from 0 to 1. a_w below 0.60 is adequate to prevent microbial growth but chemical and enzymatic reaction may continue at an unacceptable rate. Lower limit of a_w for bacterial growth is 0.90, for yeasts 0.86, for molds 0.72 and lower limit for bacterial growth is 0.60 (Hyde, 1974).The moisture content of rice was found within the standard of NFC.

The moisture content, crude protein, total ash, fat, total carbohydrate and crude fiber were found out to be 12.83%, 7.12%, 0.81%, 0.43%, 78.07% and 0.71% respectively on wet basis. HMG-N (1986) reported that the moisture content, crude protein, total ash, fat, total carbohydrate and crude fiber to be 13.7%, 6.8%, 0.6%, 0.5%,78.2% and 0.2% respectively.

Similarly, according to Acharya (1992), the moisture content, crude protein, total ash, fat, total carbohydrate and crude fiber of rice is 10.9%, 7.1%, 1.2%, 2.4%, 77.1% and 0.9% respectively. Thus, the proximate composition of rice obtained is in the range of standard values.

4.3 Determination of chemical composition of jaggery

The chemical composition of jaggery used to prepare *kasar* is tabulated in Table 4.3.

Table 4.3 Chemical composition of jaggery

Parameters	Value %
Moisture content	12.96±0.62
Total solids	87.04±0.62
TSS	85.73±0.51
Insoluble solids	1.3±0.11
Total sugar	84.83±0.7
Reducing sugar	17.01±0.36
Ash content	0.53±0.07

*The values in the Table 4.4 are the mean of the triplicates ± standard deviation.

The moisture content of jaggery used was 12.96%. According to HMG-N (1986) moisture content of jaggery is 3.9%. The deviation of the data of moisture content is due to the moisture absorbed by the jaggery from the atmosphere due to high Relative Humidity. The ash content was found out to be 0.53% whereas according to HMG-N (1986) it is 0.6%.

4.4 Sensory analysis of *kasar*

The mean sensory scores for color, flavor, mouthfeel, texture and overall acceptability for samples A were found to be 8.125±0.641,7.875±0.835,7.875±0.641,8.25±0.707 and 8.125±0.641 respectively, and that for sample B was found to be 7±0.756, 7.625±0.916, 7.25±1.165, 6.75±1.669 and 7.625±0.916 respectively. Sample A was found to be significantly better than sample B in terms of color ($p = 0.038$) and texture ($p = 0.009$). Better texture in sample A may be the result of gelatinization of starch granules adsorbed during soaking. Rice flour was fried during preparation of sample A whereas rice grain was fried during preparation of sample B which have resulted in uniform frying and better color of sample A. The mean score for color, flavor, mouthfeel, texture and overall acceptability for *kasar* A and B is shown in Fig. 4.1 below.

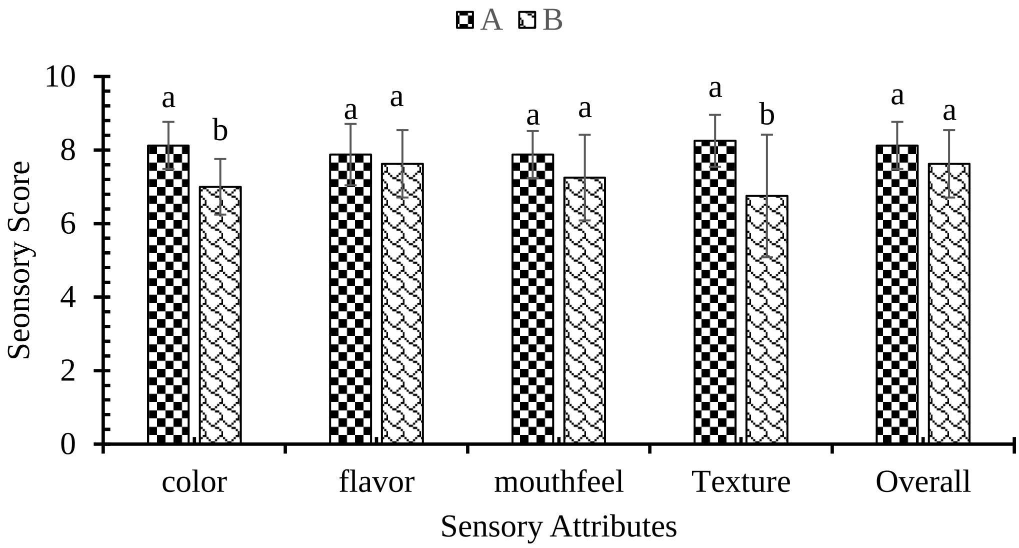

Fig. 4.1 Sensory score of *kasar*

4.5 Proximate analysis of *kasar*

Table 4.4 summarizes proximate constituent of *kasar* obtained from first method (sample A) in wet basis.

Table 4.4 Proximate of *kasar*

Parameters	**Values (%)**
Moisture	9.4±0.36
Protein	4.1±0.38
Fat	3±0.55
Ash	0.5±0.10
Crude fiber	0.2±0.08
Carbohydrate	82.5±0.4
Calcium (mg/100gm)	24.3±1.50
Iron (mg/100g)	4.63±1.16

Values are mean of triplicates ± standard deviation.

4.6 Storage stability of *kasar*

For the study of storage stability *kasar* was heat sealed in Polypropylene (PP) packets. The storage stability of *kasar* was determined by AV and PV.

4.6.1 Changes in Peroxide Value of *kasar*

Peroxides value of fat indicates the degree of primary oxidation and therefore its likeliness of becoming rancid. Peroxides are intermediated in autoxidation, which is free radical reaction that involves oxygen, leading to the deterioration of fats and oils. Hydroperoxides, classified as primary oxidation products, are flavorless but unstable intermediates that break down to form volatile decomposition products like aldehydes, ketones, alcohols and acids and other secondary oxidation products that are responsible for off-flavor development in oils (Kaleem et al., 2015).

The fat from the prepared cake was extracted and taken for analysis of peroxides. On the very first day peroxide value was found to be 1.27 meq/kg. After 15 days, it was found to be 3.42 meq/kg. Similarly, it goes on increasing order where it reaches 4.98 meq/kg, on 30^{th} day, 5.42 meq/kg 45^{th} day and 6.11 on 60^{th} days. The peroxide value exceeding 10 meq/kg is considered rancid (Pearson et al., 1981). The Peroxide Value of *kasar* was found to increase slightly only. But due to time limit, further study was not possible.

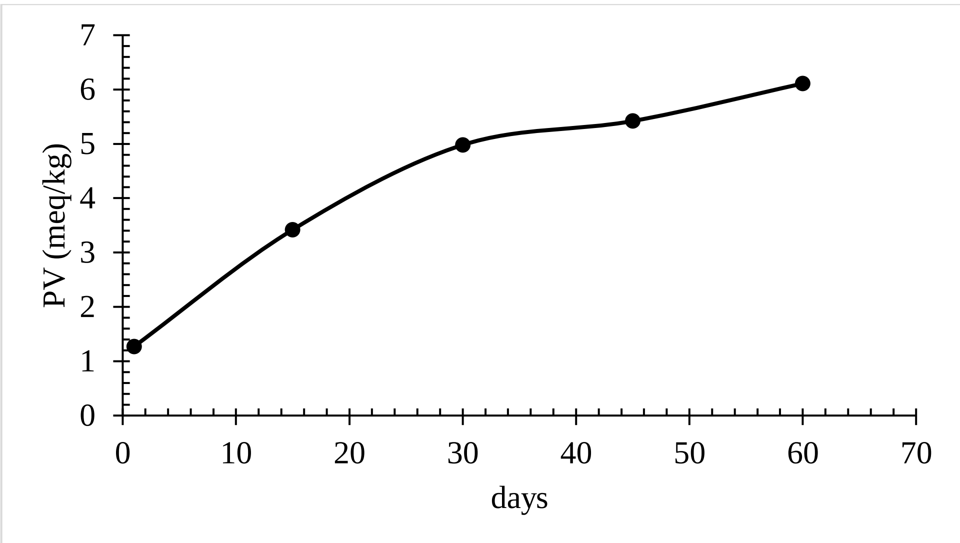

Fig. 4.2 PV value during 60 days of storage

4.6.2 Change in Acid Value of *kasar*

The fat from the prepare *kasar* was extracted and taken for analysis of acid value. On the very first day acid value was found to be 0.21 mg KOH/g. After 15 days, it is increased to 0.25 mg KOH/g. Similarly, it goes on in increasing order where it reaches 0.27 mg KOH/g on 30 days, 0.29 mg KOH/g on 45 days and 0.30 mg KOH/g on 60 days. Acid value should not exceed 0.50 mg KOH/g (Pearson et al., 1981). The Acid Value of *kasar* was found to increase slightly only. But due to time limit, further study was not possible.

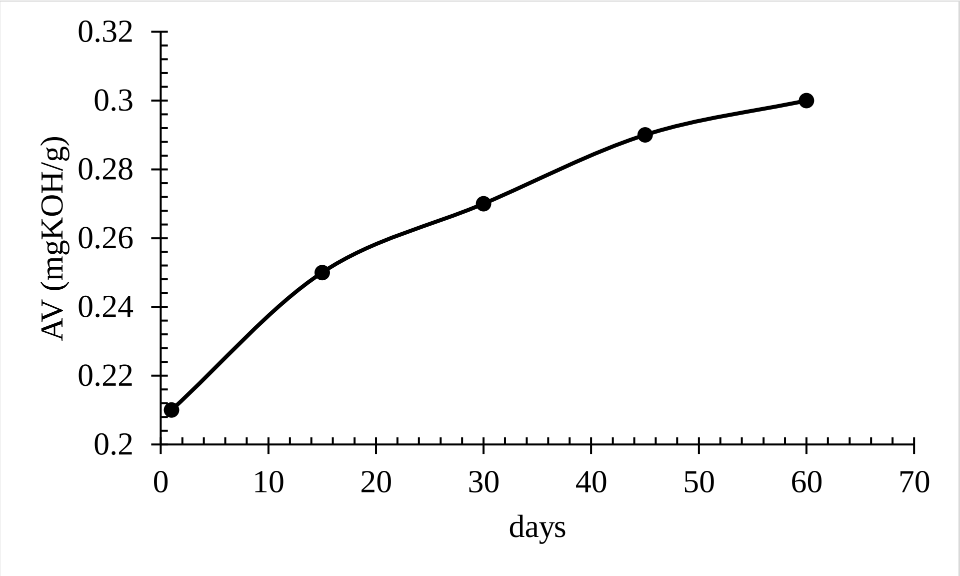

Fig. 4.3 AV value during 60 days of storage

According to Kishk (1997) free fatty acids may be produced by the oxidation of double bonds of unsaturated fatty acids esters. In advanced stage of oxidation, free fatty acids with low molecular weight were developed through the accumulation of acidic cleavage products and subsequently increased the acid value. As is the case with all fat containing foods, *kasar* is susceptible to spoilage through the auto-oxidation of unsaturated and polyunsaturated fats in oil. The presence of free fatty acids in oil is an indication of lipase activity or other hydrolytic action and the presence of enzyme lipase. Therefore, the increase in free fatty acid level which is measured by the acid value suggests that as storage period increases the extent or proneness to rancidity increases in *kasar*.

4.6.3 Cost estimation of *kasar*

600 g of *kasar* was prepared which cost Rs 47. Hence cost per 100 g of *kasar* cost Rs 7.83. The amount of raw materials used along with cost is shown in the Table 4.5.

Table 4.5 Cost of raw materials of *kasar*

Raw materials	Quantity (grams)	Cost (per kg)	Total Cost
Rice	400	45	18
jaggery	200	45	9
Ghee	30	150 per 100 gm	20

Part V

Conclusions and recommendations

5.1 Conclusions

On the basis of survey and sensory evaluation, the following conclusions can be drawn.

1. *Kasar* prepared from method A (sample A) was found to be superior in terms of color (0.038) and texture (0.009).

2. Crude protein, crude fat, ash, crude fiber and moisture content of sample A was found to be 4.1%, 3%, 0.2%, 0.5% and 9.4% respectively.

3. *Kasar* stored in polyprolyene (PP) bags was found to be shelf stable during 60 days storage. AV increased from 0.21 mg KOH/g to 0.3 mg KOH/g which is under 0.5 mg KOH/g whereas PV increased from 1.27 meq/kg to 6.11 meq/kg which is under 10 meq/kg.

5.2 Recommendation

From the research work, the following suggestions are recommended for future work:

1. Different types of rice may be used to prepare the *kasar* and compared their quality.
2. The shelf life of the *kasar* may be studied using different packaging material.
3. Sugar may be used with jaggery for the preparation of *kasar*.

PART VI

Summary

Kasar is one of the cultural and traditional foods, which is being prepared by people of *Brahmin* and *Chhetri* community. Rice flour and Jaggery are the main ingredients of *kasar*. It is the product prepared from cooked jaggary and lightly roasted rice flour and made into balls, indigenous to *Brahmin* and *Chhetri* community of Nepal. Normally, it is prepared in *bratabhandha* and marriage ceremony. It is very important item for special occasions of *Brahmin* and *Chhetri* community. It is especially prepared at the time of joyfulness.

The physical parameter like L/B ratio, Bulk density, and thousand kernel weight of rice (*kanchi mansuli*) variety was determined and was found to be 2.69, 93kg/HL, and 13.9g. The chemical analysis of rice, sesame and jaggery were found to be in the range of standard results.

The idea of making *kasar* was gathered by public survey. For the preparation of *kasar,* rice of *kanchhi mansuli* variety, sesame and jaggery was brought from the local market of Dharan. Two methods were screened from the various methods obtained from the survey. First method (Method A, Sample A) entails cleaning, soaking, draining, milling, winnowing, roasting in ghee, mixing with boiled and filtered jaggery and moulding, whereas second method (Method B, Sample B) entails taking rice, cleaning, roasting in ghee, grinding, mixing with jaggery syrup and moulding. The statistical analysis of sensory score were carried out by ANOVA in Genstat programme (for all sensory evaluation) taking one-way ANOVA blocking the effect of panelist. The proximate analysis of the optimized *kasar* was carried out and the moisture content, crude protein, crude fat, crude fiber, ash, calcium(mg/100 g) and iron(mg/100 g) was found to be 9.4±0.36%, 4.1±0.38%, 3±0.55%, 0.2±0.08%, 0.5±0.10%, 24.3±1.50mg/100 g and 4.63±1.16 mg/100 g respectively. The cost of optimized 100g of *kasar* was found to be Rs 7.83.

References

Achaya, K. T. (1984). “Everyday Indian processed foods”, National Book Trust, [ISBN 9788123710358]

Alford, J. and Duguid, N. (2003). "Seductions of rice”, Random House Canada, Canada [ISBN 1579652344].

Horwitz, W., Chichilo, P. and Reynolds, H. (1970). "Official methods of analysis of the Association of Official Analytical Chemists", Wahington, D.C., USA.

Araullo, E. V., De Padua, D. B. and Graham, M. (1976). "Rice: postharvest technology". IDRC, Ottawa, ON, CA. [ISBN 0889360677].

Aykroyd, W. R., Krishnan, B., Passmore, R. and Sundararajan, A. (1940). The rice problem in India, Calcutta Pub under the authority of and for the Indian Research Fund Association by Thacker, Spink & Co.

Adhikari, S. (2007). Comparative study on the quality between mansuli and sona-mansuli rice of eastern and central terai region of Nepal. Ph.D. Tribhuvan University, Nepal

Clarke, P. (1982). Cooking losses in rice—a preliminary study of the effect of grain breakage, Int. J. Food Sci. Technol., **17**(4), 507-511.

De Datta, S. K. (1981). "Principles and practices of rice production". Int. Rice Res. Inst. [ISBN 0471097608].

Gopalan, C., Rama Sastri, B. and Balasubramanian, S. (1971). "Nutritive value of Indian foods". National Institute of Nutrition. Hyderabad, India.

Gwong, T.B. (2011). Bhale Pothi Kasar. *Nagarik Dainik*, Nepal Republic Media Ltd., 10 December 2011, pp.6.

Putter, A. (1994). Safeguarding the genetic basis of Africa's traditional crops., *Seminar on CTA/IBPGR/KARI/UNEP*.

ITIS. (2022). Oryza sativa L. Retrieved from https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=41976&print_version=PRT&source=to_print#null.

Jaccobs B.M. (1958). "The chemical analysis of foods and food products" (3rd ed.). Asia Printograph, Shadara, Delhi.

Johnson, A. H. and Peterson M. S. (1974). Encyclo. Food technol., AVI Publishing Company. West port, Connecticut.

K.C., J.B. (2007). Traditional foods. *In:* "Technology Involved and Growth of Traditional and Modern Food Industries of Dharan", pp.5-7.

K.C., J. B. and Rai, B. K. (2007). "Basic food analysis handbook". Kathmandu, Maya K.C. Nepal.

Kent, J. and Amos, A. J. (1983). "Modern Cereal Chemistry" (1st ed.). Northern publishing Co. Liverpool.

Kharel, G.P., Acharya, P.P. and Rai, B.K. (2010). Traditional foods of Nepal. Highland. Kathmandu, Nepal.

Kondidin group (2005). Benefits of rice. Rice grower's association of Australia. Retrieved from http*:// www.Sunrice.com.au/rice/ricegrain-nutrition.asp.* [Accessed on Aug. 18, 2011].

Lewis, Y., Krishnamurthy, N., Shivashankar, S. and Natarajan, C. (1977). Quality studies on cinnamons marketed in India. **29** (9), 307-312.

Liang, J. (2003). Study exact location of mineral and anti-nutritional factors in rice grain to optimize milling-fermentation combinations for higher mineral supply for human. Ph.D. China Agri. Univ., Beijing.

Limbu, R. C. (1987). Cooking quality of some popular rice Varieties of Eastern region of Nepal, B. Tech. Thesis. Tribhuvan Univ., Nepal.

Luh, S.(1991). Utilization of broken rice (2nd Ed.). Van Nostrand Reinhold, New York.

Mallick, R.N. (1981). Rice in Nepal, Kala Prakashan, Kathmandu.

Matthias, B. (1999). Composition of rice. Retrieved from: http://www.food-Allergens.de/symposium-vol(4)/data/rice/rice-composition.html. [Accessed Aug. 18 2011].

Metcalf, S.L. and Lund D.B. (1985). Factors affecting water uptake in Milled Rice. J. of Food Sci., **6**, 1676-79.

Mungare, T., Jadhav, H., Patil, J., Hasure, R., Jadhav, B. and Singh, J. (2000). Effect of harvesting age on juice and jaggery quality and yield of different sugarcane varieties under pre-seasonal planting. *Coop. Sugar*. **32**, pp. 113-117.

Nayadamma, Y., Seshachar, B.R., Mithal, R.S. and Verma, S.P. (1999). The Wealth of India. **9**, pp. 279-293.

Nepal Food Corporation (NFC) (2062). Retrieved from http:// www.nepalfood.com/encyclopedia/rice [Accessed on September. 12, 2011].

Ohiokpehai, O. and Ramosweu, P. (1999). The role of agricultural processing and nutrition in Improving food security in Household Level Processing. Presented at National Post Harvest Conference. Sebele, Bostwana. October 6-8.

Pearson, D. (1976). "The chemical analysis of foods". Longman Group Ltd. [0443014116].

Karmacharya, H.R. (2011). Personal communication.

Pillaiyar, P.(1988). Rice post production manual. Wiley Eastern Limited. India.

Pokhrel, B. (2008). Promotion of *Bhakka* to the Restaurant level, B.Tech., Thesis. Tribhuvan Univ., Nepal.

Pradhan, B. (2005). Preparation and Quality Evaluation of *Selroti*. B.Tech. Thesis. Tribhuvan Univ., Nepal.

Rai. D. (2004), Study and Enrichment of indigenous Food *Bhakka*. B.Tech. Thesis. Tribhuvan University, Nepal.

Ranganna, S. (1986). Hand Book of Analysis and quality control for Fruits and Vegetable Products (2nd ed). Tata Mc Graw Hill Publishing Company Ltd. pp 21-24.

Raut, K. (2006), Study on the cooking quality of some of the popular varieties of rice Found in Biratnagar. B.Tech. Thesis. Tribhuvan University, Nepal.

Sagefoods (2004). Rice. Available from http:// *www.sagevfoods.com*. [Accessed on Aug. 18, 2011].

Sahu, A.P. and Saxnena, B.N. (1994). The role of dietary whole sugar- jaggery in prevention of respiratory toxicity of air toxics and in lung cancer. Toxicol. Letters. 95-154.

Singh, J., Solomon, S., & Kumar, D. (2013). Manufacturing jaggery, a product of sugarcane, as health food. Agro. technol. **11**, 7(2).

Sternberg, S.M., and J.A. Duke. “The phytochemical database.” Available online at: www.ars genome.cornell.edu/cgi-bin/WebAce/webace?db=phytochemdb

Tarino, J. L. and Loza, J. E. (1984). Processing of Nut. J. of Food Sci.. **49**,889-893.

Thakur, A.K. (1999). Potential of jaggery (Gur) manufacturing in Punjab state. Presented at National Seminar on Status, Problems and Prospects of Jaggery and Khandsari Industry in India. p. 70–76. Indian Institute of Sugarcane Research, Lucknow.

USDA. (2022). World rice production, consumption, and stocks.

Whitaker and Tannenbaum (1977). “Food protein”. AVI Publishing Company. West port, Connecticut.

Wood, R.T. (1999). The New Whole Foods Encyclopedia. Penguin Books. New York, USA.

Appendices

Appendix A

Sensory evaluation card

Sensory evaluation of *kasar*

Hedonic rating test

Name ……………………………

Date: 2078/…/…

Observe the product by tasting. Use appropriate scale to show your attitude by checking at the point that best describes your feeling of the products. Write any of defects present described below. An honest expression of your personnel feeling will help me.

S. N	Sensory parameter	Sample code number	
		A	B
1	Appearance		
2	Flavor		
3	Color		
4	Taste		
5	Texture		
6	Overall acceptability		

Judge the above characteristics on the 1-9 scale described as follows:

like extremely-9	like slightly-6	Dislike moderately-3
like very much-8	neither like nor dislike-5	Dislike very much-2
like moderately-7	dislike slightly-4	Dislike extremely-1

Signature

Appendix B

Questionnaires for the survey

Name:……………………….

Address:……………………

1. What are the different indigenous products produced on the festivals (all around the year)?
2. What are the different names of the product (*kasar*)?
3. On what occasion do you produce this product?
4. Why *kasar* not others?
5. When was it Originated (any ancient data if you know)?
6. Who taught to produce it?
7. Is this product found locally in local restaurants (to what extent and when)?
8. What are the different ingredients used for the production (with amount if possible)?
9. What are the other ingredients that can be used in the production (with amount if possible)?
10. How do you produce *kasar* (process flow chart)?
11. How difficult is it to produce?
12. What are the technical problems in the production?
13. How do you store and for how many days?
14. When it has the best aesthetic value?
15. What are its desirable sensory characteristics?
16. What is the main quality characteristics of *kasar* (that may cause product liable to rejection)?
17. What are the changes observed during storage?
18. What should be done to obtain best product?

Appendix C

Table C.1 one-way ANOVA for *kasar* type (blocking panelist) for color

Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Panelist stratum	7	1.4375	0.2054	0.26	
Panelist.*Units* stratum type	1	5.0625	5.0625	6.52	0.038
Residual	7	5.4375	0.7768		
Total	15	11.9375			

Table C.2 one-way ANOVA for *kasar* type (blocking panelist) for flavor

Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Panelist stratum	7	1.4375	0.2054	0.26	
Panelist.*Units* stratum type	1	5.0625	5.0625	6.52	0.038
Residual	7	5.4375	0.7768		
Total	15	11.9375			

Table C.3 one-way ANOVA for *kasar* type (blocking panelist) for mouthfeel

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Panelist stratum	7	1.4375	0.2054	0.26	
Panelist.*Units* stratum type	1	5.0625	5.0625	6.52	0.038
Residual	7	5.4375	0.7768		
Total	15	11.9375			

Table C.4 one-way ANOVA for *kasar* type (blocking panelist) for texture

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Panelist stratum	7	1.4375	0.2054	0.26	
Panelist.*Units* stratum type	1	5.0625	5.0625	6.52	0.038
Residual	7	5.4375	0.7768		
Total	15	11.9375			

Table C.5 one-way ANOVA for *kasar* type (blocking panelist) for overall acceptability

Source of variation	**d.f.**	**s.s.**	**m.s.**	**v.r.**	**F pr.**
Panelist stratum	7	1.4375	0.2054	0.26	
Panelist.*Units* stratum type	1	5.0625	5.0625	6.52	0.038
Residual	7	5.4375	0.7768		
Total	15	11.9375			

Photo gallery

P.1 student performing the lab test P.2 *kasar*, the product

P.3 roasted rice flour