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Sudan university of Science and Technolog

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Production of Fermented Rice Beverage by Using Sudanese Techniques in Fermentation

إنتاج مشروب مخمر من الأرز بإستخدام طرق التخمير السودانية

A Dissertation Submitted in Partial Fulfillment for the Requirements of B..Sc (Honor) Degree in Food Science and Technology

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

{(44) يُطَافُ عَلَيْهِم بِكَأْسٍ مِن مَّعِينٍ (45) بَيْضَاء لَذَّةٍ لِّلشَّارِبِينَ}

سورة الصافات

الآية (46)

DEDICATION

To our:

Families,

Teachers and Friends.

ACKNOWLEDGEMENTS

With all humbleness and gratitude render ultimate thanks and special praise to ALLAH who gave us health, power and patience to accomplish and conduct this work .

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Abstract

The aim of this study to production drink from rice using traditional Sudanese fermentation methods.

Three samples of rice drink were prepared. The first sample (unfermented beverage), the second sample (48 hours) from fermentation, and third sample (96 hours) from fermentation. A tablespoon of sugar was added to help the fermentation process, and 100 grams of each (ginger - habhean- cinnamon) were added to give the drink the distinct taste and flavor. Sensory evaluation of the beverage was performed. Based on the total evaluation, it was found that sample 3 (96 hours) was more acceptability than the other samples. An increase in moisture and carbohydrates was observed 93.2% and 5.4 respectively. A decrease in the percentage of solid solids was observed, as it was 18.4 in the first sample (time 0) and became 15.6 in the third sample (96 hours). The appropriate pH ratio was 4.8 in sample 3. 96 hours)

ملخص الدراسة

الهدف من الدراسة أنتاج مشروب مخمر من الأرز باستخدام طرق التخمير التقليدية السودانية. تم تحضير ثلاثة عينات من مشروب الأرز العينة الأولى (غير مخمره) و العينة الثانية (48 ساعة) والعينة الثالثة (96ساعة). تم إضافة معلقة كبيرة من السكر لتساعد على عملية التخمير وتم إضافة 100 جرام من كل من (الزنجبيل- الهبهان- القرفة) لإعطاء المشروب الطعم والنكهه المميزة. تم إجراء تقيم الحسي للمشروب، بناءا على التقيم الكلي وجد أن العينة3 (96ساعة) كانت الأكثر قابلية من العينات الأخرى. وتمت ملاحظة زيادة في الرطوبة والكربوهيدرات 93.2% ,5,4 .تم ملاحظة نقص في نسبة الجوامد الصلبة حيث كانت 18.4 في العينة الاولي (غير المخمرة) و أصبحت 15.6 في العينة الثالثة (96 ساعة) نسبة pH المناسبة 4.8 كانت في العينة 3(96ساعة).

CHAPTER ONE

1.INTRODUCTION

Rice is one of main food crops, and in the last year the annual Global production reached about 481 million metric tons. (US Department of Agriculture, 2014)

According to USA , each cup of cooked rice (108 gm) contains the Following nutritional information:

Colories	194
Fats	0.58
Saturated fat	0.11
Carbohydrate	41.16
Fiber	1.4
Protein	4.60
Cholesterol	0

Source: Hassan,Laith Raouf (2013)

It is also an important source of nutritional components Such as starch, minerals and vitamins.(Shin.2012)

Before the inventation of pasteurization and sterilization , Fermentation was used all over the world as method of preserving Food and is still used.

Fermentation breaks down indigestible carbohydrates and Enriches the group of essential amino acids minerals and Vitamin.(Ray *et al*, 2016)

It promotes the overall of digestion and aroma of food fermented Drinks have been a part of human life since the beginning of History and have evolved various regions of the world to reflect Natural climates and cultural traditions.

Rice drink was developed in various forms such as the very Primitive rice drink in Thailand and the highly sophisticated Alcoholic beverage such as Japanese (sake) even Korean drinks (Yakju) were originally rice and it is apopular drink among people.(Park and other,1977)

Rice drink has achieved a uniq position among alcoholic Fermentation drinks due to the pronounced flavor compared to fruit Wines.(Steinkraius,1996)

It is also has a mild and slightly sweet taste due to the hydrolysis Of starch into maltose and other sugar by action of enzymes. (Jaekel *et al*, 2010).

In the west , drinks obtained from rice extract are a good Alternative to consuming health product with desirable nutritional Properties , moreover, they provide option to replace dairy and soy Products.(Fagundes,2012)

Because many people are lactose intolerant and allergic to soy Product (crust,2013).

1.1 General objective:

The main goal of this study was to use Sudanese traditional fermentation method to produce nutrition and acceptable fermented rice beverage with

1.2 Specific objectives:

1. To study the physiochemical and sensory characteristics of Fermented rice beverage.
2. To study the maximum time of fermentation

CHPTER TWO

2.LITERATURE REVEIEW

2.1. Rice:

Cultured rice, or short for rice (in Latin: Oryza sativa) is a plant species that follows the genus of rice (in Latin: Oryza) and is the staple food for more than half of the world's population, especially in Asia. It is a food grain crop.

2.1.1 . Home of rice:

The original home of rice is not known precisely, but it is likely to be from East Asia, as it began to be cultivated in the Yangtze River Valley in China since 2000 B.C. It is also said that it has been present in India since ancient times and was transported to the East and Europe, and it is said that it was transported to Egypt during the era of the Caliphs. Al-Rashideen and the Arabs took it to Africa, then moved to Europe after the Crusades. It was planted in Italy in the 15th century and transplanted in America in the 17th century. Today rice is grown on all continents.

2.1.2 . Botanical description:

Rice is an annual herbaceous plant that belongs to the grass family. Rice is 50 to 180 cm tall. The fruit is a well that grows on a spike

The root system is fibrous and superficial, and spreads in watery rice varieties horizontally up to a distance of 20-40 cm, while the roots of high-zone varieties spread deep into the soil. The stem is upright and hollow, and its height ranges between 60 and 180 cm. On the main stem, many molars form in fertile and irrigated soil, the number of which may reach 50. The leaves are interchangeable. The aerial parts of the plant contain the pigment anthocyanin

The flower cluster is single or combined, and the blossom is partially or completely out of the sheath upon maturity. The number of flowers ranges

between 75 and 100, and each spike contains three flowers, the top of which is fertile only, while the two lower flowers turn into sterile leaves. The flower consists of six stamens, each of which carries an ankle containing pollen grains, and a short pen at the end carries two feathery mesamens and an ovary made of a single cell containing a single egg. The flower parts are surrounded by two small inner scales and an external sap. It can be called awn or sometimes awnless.

2.1.3. Rice cultivation:

- It is usually grown in flooded lands. The success of rice cultivation depends on three main factors.

- The temperature must not be below 21 degrees Celsius throughout the growing season, which extends from 4 to 6 months.

- The abundance of renewable water that floods the rice cultivated land throughout the growing period.

- Soil fertility, preferably rich in organic matter.

Rice plant

There is a type of rice grown in the United States of America that does not need to be immersed in water, but rather needs wet soil for long periods and is called mountain rice. There are many varieties of rice in the world, in India alone there are 1100 varieties in addition to 1300 varieties in the rest of the world.

2.1.4. Botanical classification:

The genus Oryza included about 23 specific species, two of which are used in agriculture: (in Latin: Oryza glaberrima Steud), which is grown in limited areas in Africa, its grains are dark in color and of poor type, and successfully crossbred with the type of cultivated rice (in Latin: Oryza sativa) which It

includes most of the cultivated varieties in the world, and is classified into three groups: the Indian group (Latin: Indicas) that predominates in tropical and subtropical regions, and the Japanese group (Latin: Japonicas), which is grown only in temperate and subtropical regions. The Java group (Latin: Javanicas) is mainly cultivated in Indonesia

There are also many diploid or tetraploid wild species, spread in America, Africa, India, Indonesia, the Philippines, Malaysia and others.

2.1.5. Rice production:

Rice cultivation follows important industries such as milling and bleaching rice. Various products are produced from the rice bleaching process, including 18% husks, 9% return, 56% healthy rice, 15% broken and 2% impurities, and rice husks are used in the manufacture of paper and organic fertilizer

2.2.Cinnamon:

Cinnamon is the bark of a dense tropical evergreen tree that can reach a height of ten to forty meters. It is native to Sri Lanka but is also cultivated in Southeast Asia, South America and Western India. It is a samorobic family with upright stems 3 to 5 meters high, the leaves are successive compound, the flowers are small yellow, and the fruit is small, resembling a carnation. Cinnamon peels contain volatile oils, up to 4%.

2.2.1. Curative effects:

The decoction of cinnamon bark powder is useful for nausea, vomiting, diarrhea, and muscle pain, increases salivation and gastric juice, reduces high blood pressure, and is also an appetizer. And cinnamon has a substance that makes fat cells more responsive to insulin, which regulates the process of breaking down sugar in the blood and consuming it in cells in the body and converting it to energy. This substance phenolic antioxidant and reduces the

side effects of diabetes. And there is no in cinnamon oil, which is added to food.

2.2.2. Food uses:

As a hot drink, students are added to tea, and in Iraq it is called student tea

Cinnamon is added to desserts and pastries to give it the distinct taste as in apple pie

Cinnamon is added to the chewing gum, and it is known as the darsin gum, which gives the mouth a good smell and breath

2.3.Ginger:

It is a botanical species of the genus Ginger of the Zingiberaceae family, which is a tropical plant. Its roots are used under the soil, which contain volatile oil, have a pungent smell and a pungent taste, and are either squirrel or yellowish-white in color.

Ginger has yellow flowers with purple lips, and ginger is only extracted when its spear leaves are withering. And do not grin it before drying it.

Ginger rhizomes contain volatile oils and resins, the most important of which are gingerols, starch and gels.

It is abundant in East India, the Philippines, China, Sri Lanka, Mexico, Pakistan and Jamaica, and the best types of Jamaican ginger are in Jamaica.

2.3.1.Uses of ginger

It is used as a condiment and as a seasoning in preparing foods and giving them a distinctive taste. Ginger uses its roots and stems buried in the ground (rhizomes)

It is used as an infusion, so ginger tea is a repellent of winds, it is used in colds, it is useful in digestion and preventing cramps, as it is digestive and

repellent of gases and is useful in the treatment of gout, and it is not given to pregnant women.

Taking it daily can interfere with the absorption of iron and fat-soluble vitamins such as vitamin K, E, D, A, antibiotic derivatives, digoxin and phenotoin.

Since ancient times, the earthy stem (rhizome) of the ginger plant was used as an official and popular remedy in Asia and India, and the Spaniards transported ginger to America and ginger began to be cultivated in abundance in western India. Ginger is abundant in East India, the Philippines, China, Sri Lanka, Mexico, Pakistan, Jamaica, Japan, West Africa, the Caribbean Islands, and the best types of Jamaican ginger in Jamaica. It was also an important part of the Arab tradition of using plants.

For example, ginger has been used in China for more than 2000 years as an aid to digestion, and in treating intestinal confusion, diarrhea and nausea. It has also been used to help treat arthritis, colic, and some other heart problems. In addition to these therapeutic uses, ginger has occupied a great position around the world as one of the most widely used spices, and as a panacea for colds

2.3.2.Cultivate it:

Ginger produces clusters of white and pink flower buds that bloom into yellow flowers. Due to its aesthetic appeal and adaptability in hot climates, it is used in landscapes around homes in tropical regions. It is a perennial reed-like plant, with leafy stems that renew annually, and its length is from 3 -4 feet. Traditionally, the roots are collected when the stem has hardened and are immediately burned or washed, scraped, to eliminate it and prevent budding. Zingiberaceae perisperm is used as a sweetener by the Bantu, and also as a condiment and diuretic

2.3.3.Global production:

In 2013, India continued to be the world leader in ginger production with a global share of about 33%, followed by China (19%), Indonesia and Nigeria

2.3.4. Ginger Supplements:

- Repellent to gases and wind.
- Enters in the composition of drugs dilating blood vessels.
- Warm and softeningIt increases in conservation.
- A way to treat diseases of the stomach and intestines.
- It resurrects digestion.
- It strengthens the nerves.
- It strengthens the body's immune system to activate the glands - meaning that it is a natural antibiotic.
- Strengthens hormones and blood, tonic for blood circulation.
- It opens the plug and expels the phlegm if chewed with the mastic.
- Heated antiseptic and fortifying tonic.
- And remove moisture from the head and throat.

2.3.5. Diseases treated by ginger:

- Throat and tracheal cleansing, coughing and expelling phlegm
- For insomnia, anxiety and nervous tension.
- Several studies have found that ginger is an effective treatment for nausea because it contains vitamin B6, which is a very fast treatment for nausea as it is absorbed very quickly in the body.
- Delightful and refreshing.
- To strengthen the body, activity, stimulate reproductive energy, fight diseases, and avoid fatigue and lethargy.
- To cleanse and strengthen the stomach, and as a laxative to treat constipation and cramping caused by diarrhea.

- To open appetite for food and treat indigestion.
- To warm the body and resist winter diseases (for colds, colds and flu
- For asthma distress.
- To lighten liver clogs, liver weakness and laziness.

2.3.6. Damage of ginger:

Too much ginger can cause a rapid heartbeat.

Ginger can cause stress and central nervous system function.

Ginger causes severe bleeding for those who take it with some herbs. Chamomile, fenugreek, clove.

2.4. Habhan:

Habhan (pronounced: / æbbæˈhæːn /), is a name for two species of the scientific plant Yetaria cardamom - green cardamom - Elettaria Cardamomim and Amomum - black cardamom (Amomum) - from the tentacle family of the Zingiberaceae family. Habhan is native to India and Sri Lanka. The plant plant is actually "cardamom love". Cardamom is added in countries such as India and Iraq for tea, and they are served for tea, and they are supplied in Egypt for destined coffee, and for hours they add to it, such as rice and soup.

2.2. Fermentation:

The word "ferment" is derived from the Latin verb fervere, which means to boil. It is thought to have been first used in the late 14th century in alchemy, but only in a broad sense. It was not used in the modern scientific sense until around (1600) .

is a metabolic process that produces chemical changes in organic substrates through the action of enzymes. In biochemistry, it is narrowly defined as the extraction of energy from carbohydrates in the absence of oxygen. In the context of food production, it may more broadly refer to any process in which

the activity of microorganisms brings about a desirable change to a foodstuff or beverage The science of fermentation is known as zymology .

In microorganisms, fermentation is the primary means of producing adenosine triphosphate (ATP) by the degradation of organic nutrients anaerobically. Humans have used fermentation to produce foodstuffs and beverages since the Neolithic age. For example, fermentation is used for preservation in a process that produces lactic acid found in such sour foods as pickled cucumbers, kombucha, kimchi, and yogurt, as well as for producing alcoholic beverages such as wine and beer. Fermentation also occurs within the gastrointestinal tracts of all animals, including humans.

Traditional fermented food preparation is one of the oldest biotechnological processes around the world in which microorganisms play a crucial role in improvement of sensory characteristics, bioenrichment, health promoting attributes, and preservation of foods.

Fermentation helps reduce indigestible carbohydrates, enriches the group of essential amino acids, vitamins and minerals, and increases the overall quality, digestibility, taste and aroma of food (Bandio,2003).This unusual feature of fermented foods is helpful in maintaining the healthy composition of the intestinal microbes necessary for protection against various diseases and for maintaining the physiological balance and relationship between the gut and the brain of the host. From this point of view, fermented food is categorized as "naturally fortified functional food". The term "functional food" was first introduced in Japan in the mid-1970s. It refers to processed foods that contain physiologically active ingredients that aid specific bodily functions beyond basic nutrition(Stanton,2002). A recently proposed working definition of functional food is: “A food that can be shown to beneficially affect one or more target functions in the body, beyond the influence of additive nutritional intake, in a manner relevant to improving health and well-being and / or reducing the risk of disease (Devuyst,2002).

Increased global interest in cereal-based fermented products due to low fat / cholesterol, high mineral content, dietary fiber, and phytochemical content(Bandio,2003). In addition to essential nutrients, grain-based fermented food conferred many health-promoting properties, as it contains beneficial edible microbes, also called probiotics, fermentable sugars (of microbial and dietary origin, such as prebiotics), and digestive aids such as a group of microbes. In addition, multiple strains or multiple species probiotics may provide greater beneficial effects than mono-strain cultures. The synergistic actions of these exogenous microorganisms create a social environment for symbiosis (indigenous colonial organisms), inhibit the growth of intestinal pathogens, are beneficial for digestion and absorption, and produce various metabolites including short-chain fatty acids, especially butyrate, which have a positive effect on the epithelial lining. For the digestive system, it promotes the differentiation of mucous cells, and this may also enhance the immune barrier function of the epithelium, and on peristalsis, which improves transit(Weeb ,2002) Cereal ingredients are the natural growth media / vectors of probiotics and have the ability to protect organisms in the harsh environment of the intestine(Lin ,2003) Given these beneficial effects, grain-based fermented foods are becoming more popular than traditional dairy-based products, especially in Japan and Europe(Saarela,2002) The market for non-dairy probiotic drinks is expanding at a projected annual growth rate of 15% (2013-2015). The market is expected to reach 65 billion yen by 2016, and in this regard, dairy-based products account for nearly 43% of the market.

2.2.1. Biological role:

Along with photosynthesis and aerobic respiration, fermentation is a method to extract energy from molecules. This method is the only one common to all bacteria and eukaryotes. It is therefore considered the oldest metabolic

pathway, suitable for primeval environments--before plantlife on Earth, that is, before oxygen in the atmosphere. (Tobin,Allan,2005)

Yeast, a form of fungus, occurs in almost any environment ca pable of supporting microbes, from the skins of fruits to the guts of insects and mammals to the deep ocean. Yeasts convert (break down) sugar-rich molecules to produce ethanol and carbon dioxide (Martini,1992)

Basic mechanisms for fermentation remain present in all cells of higher organisms. Mammalian muscle carries out fermentation during periods of intense exercise where oxygen supply becomes limited, resulting in the creation of lactic acid In invertebrates, fermentation also produces succinate and alanine .(Broda,2014)

Fermentative bacteria play an essential role in the production of methane in habitats ranging from the rumens of cattle to sewage digesters and freshwater sediments. They produce hydrogen, carbon dioxide, formate and acetate and carboxylic acids. Then consortia of microbes convert the carbon dioxide and acetate to methane. Acetogenic bacteria oxidize the acids, obtaining more acetate and either hydrogen or formate. Finally, methanogens (in the domain Archea) convert acetate to methane. (Ferry, septemper1992).

2.2.2. History of the use:

The use of fermentation, particularly for beverages, has existed since the Neolithic and has been documented dating from 7000–6600 BCE in Jiahu, China,(Wang,2004)

5000 BCE in India, Ayurveda mentions many Medicated Wines, 6000 BCE in Georgia,(Grando,2006)

3150 BCE in ancient Egypt(Polsineli,2003)

3000 BCE in Babylon 2000 BCE in pre-Hispanic Mexico, and 1500 BC in Sudan.(Dirar,1993)

Fermented foods have a religious significance in Judaism and Christianity.

2.2.3. Fermentation products:

2.2.3.1. Ethanol:

In ethanol fermentation, one glucose molecule is converted into two ethanol molecules and two carbon dioxide molecules.(Heller, Craig 2003)

It is used to make bread dough rise: the carbon dioxide forms bubbles, expanding the dough into a foam.(Distefano,1997) The ethanol is the intoxicating agent in alcoholic beverages such as wine, beer and liquor.(alcoholic.Drugs.com) Fermentation of feedstocks, including sugarcane, corn, and sugar beets, produces ethanol that is added to gasoline. In some species of fish, including goldfish and carp, it provides energy when oxygen is scarce (along with lactic acid fermentation).(Verhage,1993).

2.2.3.2. Lactic acid:

Homolactic fermentation (producing only lactic acid) is the simplest type of fermentation. Pyruvate from glycolysis undergoes a simple redox reaction, forming lactic acid. It is probably the only respiration process that does not produce a gas as a byproduct. Overall, one molecule of glucose (or any six-carbon sugar) is converted to two molecules of lactic acid.

$$C_6H_{12}O_6 \rightarrow 2\ CH_3CHOHCOOH$$

It occurs in the muscles of animals when they need energy faster than the blood can supply oxygen. It also occurs in some kinds of bacteria (such as lactobacilli) and some fungi. It is the type of bacteria that convert lactose into lactic acid in yogurt, giving it its sour taste. These lactic acid bacteria can carry out either homolactic fermentation, where the end-product is mostly lactic acid, or heterolactic fermentation, where some lactate is further metabolized to ethanol and carbon dioxide(Mark,2006) (via the phosphoketolase pathway), acetate, or other metabolic products, e.g:

$$C_6H_{12}O_6 \rightarrow CH_3CHOHCOOH + C_2H_5OH + CO_2$$

If lactose is fermented (as in yogurts and cheeses), it is first converted into glucose and galactose (both six-carbon sugars with the same atomic formula):

$$C_{12}H_{22}O_{11} + H_2O \rightarrow 2\ C_6H_{12}O_6$$

Heterolactic fermentation is in a sense intermediate between lactic acid fermentation and other types, e.g. alcoholic fermentation.

2.2.3.3. Hydrogen gas:

Hydrogen gas is produced in many types of fermentation as a way to regenerate NAD+ from NADH. Electrons are transferred to ferredoxin, which in turn is oxidized by hydrogenase, producing H_2. Hydrogen gas is a substrate for methanogens and sulfate reducers, which keep the concentration of

hydrogen low and favor the production of such an energy-rich compound, (Park,Jack.1996) but hydrogen gas at a fairly high concentration can nevertheless be formed, as in flatus.

2.2.3.4. Alternative Protein:

Fermentation can be applied to generate alternative protein sources. For instance, plant based protein foods such as sauerkraut and kimchi, tofu and tempeh are produced using fermentation. However, fermentation can also be used to culture animal products made from non living material in vitro. Eggs, honey, cheese and milk are all examples which are made of various proteins. These proteins can be produced using acellular agriculture - this particular application of fermentation.

2.2.4.What is fermented rice wine:

Rice wine is an alcoholic beverage fermented and distilled from rice, traditionally consumed in East Asia, Southeast Asia and Northeast India. Rice wine is made by the fermentation of rice starch that has been converted to sugars. Microbes are the source of the enzymes that convert the starches to sugar

2.2.4.1. Benefits of fermented rice:

Works to facilitate the digestive process(rich in enzymes and probiotics that aid in digestion and help us maintain good flora in our gut).

Resistance to dehydration, as it provides the body with balanced proportions of water, which maintains body moisture like coconut water.

The treatment of diarrhea acts as an impermeable blocking fluids Immunity booster contains a high percentage of dietary fiber, which not only increases one's sense of satiety, but also increases immunity strength.

It contains essential amino acids and antioxidants that aid in cell renewal

Contains vitamin B2-B6 - folic acid is useful for children because it is free of gluten and because it is vegetarian from rice only, and the digestive and nutritional value makes it a good choice for children.

In terms of beauty, improving the skin (preventing spots and freckles - lightening, moisturizing the skin and anti-aging).

(Amazake –super –health- Japanese – fermented –rice drink)

2.2.5. Sudanese fermented food:.

Sudan has about 60 different kinds of fermented food products prepared from a wide range of substrates or bases in which fermentation takes place of these , half are made from sorghum or millet which have been an important part of sudan's food culture for thousands of years.

2.2.5.1.Sharbot:

It is a famous Sudanese drink , people tend to have it on eid Aludhia after enjoing the sacrifice . the originates from northern state where it was eaten by the ancient Nubian civilization around the nile basin and then spread in the rest of the country

Consist of:

Water – date – additives (hebahan- ginger- cinnamon – fenugreek)

2.2.5.2. preparation of sharbot:

Date are soaked in water by a certain percentage (the ratio varies But the toddler is 2:1/date : water) spice and suger additives as desired , and cloth in container and away from sun and air until it gets old and acquires alittle tart greed the drink then filtered from date and impurities and then paked in glass container (the best) or plastic (soft drinks containers) and kept in refrigerator or freezer as desired and served cold. some women boil the mixture before a 24 hour legacy helping to blend comes and decompose dates and spices .

2.2.4.2. List of rice wines

Table (2.1): List of rice wines

Names	Place of origin	Region of origin	Description
Agkud	Philippines	Southeast Asia	Fermented rice paste or rice of the Manobo people fromBukidnon.
Pangasi	philippines	Southeast Asia	Rice wine with ginger from the Visayas and Mindanao island of the Philippines sometimes made with cassava
Apong	India	South Asia	Ingigenous to the missing tribe , an indigenous Assamese community from the north easteren states of Assam and Arunachal Pradesh
Xaaj pani	India	South Asia	Made of fermented sticky rice by Ahom community of Assam
Sake	Japan	East Asia	The term "sake" in Japanese.literally means "alcohol" and the Japanese rice wine usually termed nihonshu("Japanese liquor" in japan it is the most widely known type of rice wine in north America because of its ubiquitous appearance in Japanese restaurants)
Mijiu	China	East Asia	A clear ,sweet liqueur made from fermented glutinous rice
Huamgjiu	China	East Asia	Fermented literally "yellow wine" or yellow liquor with colors varing from clear to brown or brownish red
Makgeolli	Korea	East Asia	Milkey

2.2.5.3. Benefits of sharbot:

- Help to get rid of the feeling of bloating .
- Help in digestion well.

CHPTER THREE

3. MATERIALS AND METHOD

3.1. Materials:

3.1.1. Rice:

Al-Sadara rice was used. It was brought from (Al-Ihsan Commercial Center).

3.1.2. Spices:

Spices (ginger - cinnamon - cardamom)were from the Bahari local market

3.2. Method:

3.2.1. Preparation of fermented rice beverage:

A large, deep bowl was filled with 14-15 cups of water, the ratio of water to rice was (2: 1/water : rice)

water was boiled, then after that the rice was soaked in boiling water and covered in an airtight container for a period ranging from one to two hours until the rice reaches a level of maturity where the rice absorbs the water.

After that, the rice was mixed with a mixer and a tablespoon of sugar is added after the mixing process ends.

After mixed, add 100 grams of each of ginger, Habhean and cinnamon to give the drink a delicious flavor.

After mixed and add of spice the first sample (un fermented) was taken and it was in zero time but in airtight plastic or glass containers away from sun and air to ferment for 2-4 days as desired (fermented in the room temperature) . after 2 days (48 hours) of fermentation the second sample was taken.

The sample three was taken on the fourth day(96h) of fermentation. During fermentation, a little liquid is noticed at the bottom of the pot and the smell of the rice changes to a distinctive smell and the appearance of foam indicating the completion of the fermentation process. When fermentation, fermentation is preferred at room temperature, because if the temperature is high, the koji enzyme does not work adequately and will not become sweet on the contrary, if the temperature is too low, lactic acid fermentation develops, which causes a lot of bacterial proliferation. (Japanese fermented –rice drink)

After the fermentation period is completed, the drink is rubbed using (mufraka) Sudanese traditional machine , which is used to mix the liquids for the mix liquid at the bottom of the pot is filtered using a sieve or a clean cloth (Water can be added to the residue from the filtration process and re-fermented again) It is stored in the refrigerator and can be stored from week to month.

3.2.2.Chemical analysis:

3.2.2.1. Moisture determination:

Moisture was determined according to the AOAC. Two grams of sample were dried in an oven at 103 ℃ for three hours, the test repeated three times then the average was taken

$$\text{moisture\%} = \frac{\text{weight of loss (gm)}}{\text{weight of sample}} \times 100\text{tureweight of loss (gm)/weight of sample} \times 100$$

3.2.2.2. Total solids:

Total solids content was determined by forced draft oven method according to Bradley *et al* .(1992). aluminum dishes were dried for five hours at 100 and stored in a clean desecrator until used Quickly and accurately 3 ± 0.5 of sample were weighted into per weighed dish on an analytical balance . the dishes with the cover under each were placed on the metal shelf in the forced draft oven for 16 hours , removed from the oven and cooled in the dessicator for at least 30 minutes or until they reached room temperature and then weighted . the total solid content was then calculated as follows:

$$\text{Total solid \%} = \frac{\text{weight after drying}}{\text{weight of sample}} \times 100 \text{lsolid \%=weight after drying/weight of sample} \times 100$$

3.2.2.3. Ash content:

Ash content of the sample was determined according to the method of AOAC (1990) as follows: Tow grams of sample were placed in a clean dry pre-weighed crucible, and then the crucible with its content ignited in a muffle furnace at about 550c for 3hours or more until light gray ash was obtained. The crucible was removed from the furnace to a esiccators to cool and then weighed. The crucible was reignited in the furnace and allowed to cooling until a constant weight was obtained. Ash content was calculated using following equation:

$$AC\% = \frac{W2 - W1}{W3} \times 100$$

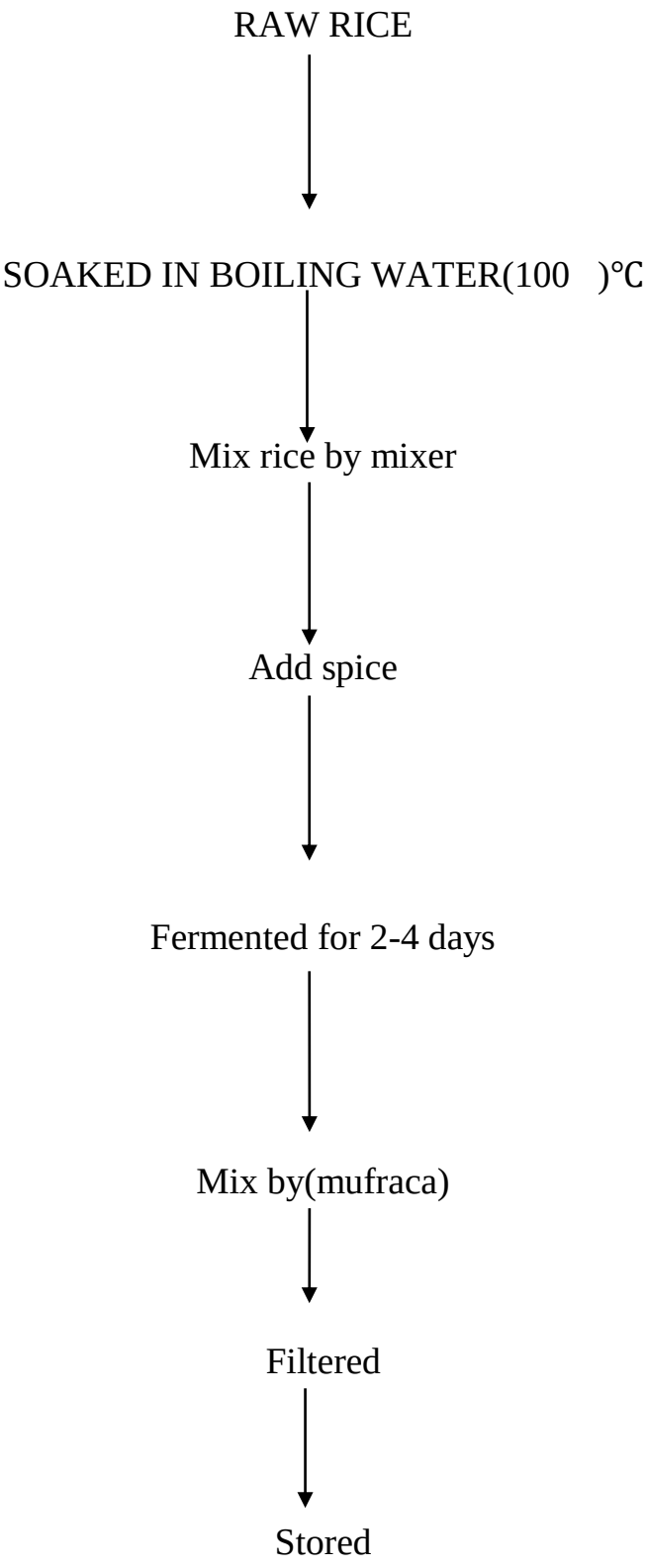

Figure 1: Production of fermented rice beverage

3.2.2. 4. Protein content:

Nitrogen content determination using Kjedal technique according to AOAC (2000) . about 2 gm of sample was weighted accurately into kjedal flask , 4 gm of catalyst mixture and 35 ml of concentrated sulphuric acid were added , the flask was plced in the digestion equipment for 24 hours . the digested sample was then placed in the distillation apparatus 20 ml of 40% NaOH were added and the ammonia evolved was received in 8ml of 2% boric acid solution. The trapped ammonia was titrated against 0.02N/HCL using universal indicator(Methyl red + bromocresol green).

$$\mathrm{N\%} = \frac{\text{Volume of HCL} \times 0.02\mathrm{N/HCL} \times 14}{\text{weight of sample}} \times 100$$

$\mathrm{protein\%} = \mathrm{N} \times 6.38 \mathrm{einN} \times 6.38$

3.2.2.5.pH:

pH of the sample was determined by using a digital pH meter at 25℃.

3.2.3. Sensory evaluation:

Sensory evaluation of fermented rice beverage was done by seventeen panelist of five hedonic rating . hedonic rating is used to measure the consumer acceptability of food product .samples were served to the panelist at one session . the acceptability of the product was rated based on a scale of point ranging from "like extremely to dislike extremely " according to the following instruction:

Please taste these samples and check how much do you like or dislike each one . use the appropriate scale to show your attitude by checking at the point that best describes your feeling about the sample. Please give a reason for the attitude . remember you are the only one who can tell what you like . an honest expression of your personal feeling will help us:

Response	Points
Excellent	5

Very good	4
Good	3
Acceptable	2
Unacceptable	1

3.2.4. Statistical analysis:

Average scores secured by 3 samples and the results were analyzed for one way ANOVA (analysis of variance) using MINTAB-10 software

CHPTER FOUR

4.RESULTS AND DISCUSSION

4.1.Chemical and physicochemical characteristics of fermented rice beverage:

Result of the proximate composition of rice are presented in Table(4- 1) rice contained high level of moisture and carbohydrate Were 93.99 and 5. 4

respectively. while the decrease levels of Protein , fat , fiber 1.87 ,0.18 ,0.01 and respectively.

4.2. Effect of fermentation time on the fermented rice beverage:

4.2.1 Changeof pH during fermentation of different samples of fermented rice beverage:

During fermentation process there were significant difference

($P \leq 0.05$) decrease in pH levels in sample 2 (48h) and sample 3 (96h) 5.3 and 4.8, respectively .while sample1(unfermented) was 6.6 as show in table (4 – 2)

The decreases in PH are due to increased acid production during fermentation process as result of fermented sugar which produce acetic and lactic acid in to ratio of 1.5:1 as reported by Devries *et al* . (1967)

4.2.1Change of total soluble solid (Tss) during fermentation of different samples of fermented rice beverage:

In table (4-2) change in (Tss) during fermentation of fermented rice beverage there were significant difference ($P \leq 0.05$) decrease in sample 2 (48 H) and sample 3 (96h) 17.63 and sample1 was 18.1 . By extending the fermentation period to (96h) the rate of TSS decrease to 15.22 found similar decreases in TSS In traditional processing microbial and physicochemical change During fermentation of malwa (Muyanj *et al*, 2010).

4.2.2. Change of total sugars during fermentation of rice fermented beverage:

There were significant ($P \leq 0.05$) decrease in sugar levels in the sample2 (48h) and sample3 (96h) 10.7, 10.3 respectively will sample1(unfermented) was 11.3

4.2.3 .Change of acidity during fermentation of rice beverage:

there were significant different same table(4 -2) shows the increase of acidity in samples were in sample1(unfermented beverage) was0.23 by extending of fermentation period the rates of increase were in (48h) and(96h) 0.34 and 0.38 the increased of acidity is explain by accumulation of lactic acid and other organic acid produced during fermentation of beverage (Sefa *et al*,2003).

4.3. Sensory evaluation of fermented rice beverage:

4.3.1. Flavor:

As it table (4-3) and fig. (2) statistical analysis There was significant different ($P \leq 0.05$) in flavor scores in all of fermented rice beverages samples were sample1 ,sample 2 and sample3 was 3.8 , 4.11 ,4.11 respectively.

4.3.2. Color:

The color score of fermented rice beverage at sample1(unfermented beveragetime),sample2(48h) and sample3(96h) were 4.4, 4.4 and 4.2 ,respectively and the statistical analysis show that no significant difference ($P \leq 0.05$).

4.3.3. Taste:

The fermented rice beverage in sample1(unfermented beverage) , Sample 2 (48h) and sample 3 (96) were 3.7 ,3.9 and 4.05respectively . The statistical analysis show that was significant different ($P \leq 0.05$)

4.3.4. Apperance:

The fermented rice beverage in sample 1 (unfermented beverage) , sample2(48h) and sample3(96h) were 3.7,3.9and 4.4 respectively. The statistical analysis show that was significant difference($P \leq 0.05$) in all samples

4.3.4. Overall acceptability:

The fermented rice beverage sample3(96h) recoded maximum overall acceptability score (4.2) compared to sample1(0time) and sample2(48h) were 3.8, 4.0 respectively and statistical analysis showed significant difference $P \leq 0.05$

Table (4. 1): Proximate composition of fermented rice beverage:

Samples	Moisture	Protein	Fat	COH	Ash	Fiber
Sample1	92.9^{a} ± 0.3	3.47^{a} ± 0.014	1.74^{a} ± 0.01	1.60^{ab} ± 0.42	0.19^{b} ± 0.1	0.03^{b} ± 0.05
Sample2	92.8^{b} ± 0.3	2.26^{a} ± 0.012	1.2^{b} ± 0.01	3.6^{b} ± 0.42	0.15^{a} ± 0.02	0.02^{a} ± 0.03
Sample3	93.5^{ab} ± 0.4	1.87^{a} ± 0.014	0.18^{a} ± 0.01	5.40^{a} ± 0.43	0.42^{ba} ± 0.01	0.01^{b} ± 0.02

All the values are average of 3 trials

Values are means ± SD.

Mean having different superscripts in each column are significantly different ($P \pm 0.05$)

SD=standard deviation

Table (4.2): Effect of fermentation time on physicochemical characteristics of fermented rice beverage:

Samples	Acidity	Total sugar	TSS	pH
Sample 1	0.23^{a}	11.3^{A}	18.4^{A}	6.6^{A}

	± 0.01	± 0.08	± 0.23	± 0.2
Sample 2	0.34^{a} ± 0.034	10.7^{AB} ± 0.46	17.6^{B} ± 0.25	5.3^{B} ± 0.3
Sample 3	0.38^{B} ± 0.025	10.7^{B} ± 0.3	15.5^{c} ± 0.17	4.8^{B} ± 0.12

All values are average of 3 trials

Values are means $\pm$ SD

Means having different superscripts in each column are significantly different ($P \leq 0.05$)

SD=Standard deviation.

Table (4.3): Effect of fermentation time on sensory characteristics:

Samples	Flavor	Color	Taste	Appearance	Overall acceptability
Sample 1(0time)	3.8^{A}	4.41^{A}	3.7^{A}	3.7^{A}	3.8^{A}
Sample 2(48h)	4.11^{B}	4.47^{A}	3.9^{B}	3.9^{AB}	4.05^{AB}
Sample 3(96h)	4.11^{AB}	4.2^{A}	4.05^{AB}	4.4^{AB}	4.2^{B}

Mean have the same superscript in column indicates no significant difference t($P \leq 0.05$)

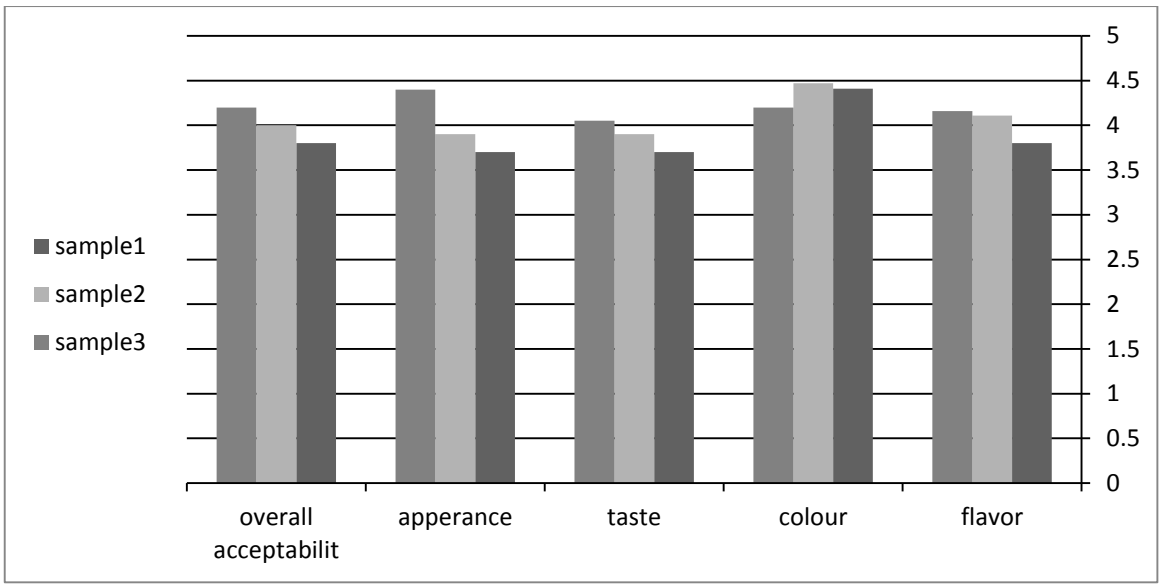

Figure 2: Sensory characteristics of fermented rice beverage

CHAPTER FIVE

5.CONCLUSION AND RECOMMENDATION

5.1. Conclusion:

1. This study showed that maximum time to produce fermented rice beverage by using Sudanese techniques in fermentation with natural color and distinct flavor that a 4 days of fermentation period.
2. The most acceptable rice beverage was sample 3 (96.h).

5.2. Recommendation:

1. Fermented rice beverage can be developed with addition of flavors to produce a drink with acceptable sensory properties .
2. It is recommended for the food industry to introduce the fermented rice beverage in market because the market of functional beverage is growing around the world.

3. Further study are recommended plant to extend the shelf life as in the mundas of Orissa and central india .

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