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# Design and Production of fiber enriched Beer by optimizing Freekeh into Brewing Process

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**Abstract-Brewing is the process of production of malt beverages. Beers like Ale, Alt, Pilsner, Muncher, Porter, Lambric are the main malt beverages produces by the method called Brewing. Historically, Beer was produced from malted barley. It is commercially produced by the controlled fermentation of wort, nitrogenous compounds, liquids rich in sugars, trace elements and sulphur compounds extracted from barley. To lessen the import costs, we want to produce a beer that may the similar characteristics like beer from another cereal, Freekeh. Freekeh is one of the categorie of wheat. It is a cereal made from Green Durum wheat that is roasted and rubbed to makes its flavor. Freekeh used in brewing after processing gives a good mouth feel rather that that of a normal Barley beer. It contains full of fiber content (3 times as much as brown rice) which has been shown to improve digestion, and assists to control weight. The present study gives a good result in terms of taste, nutrient content etc.**

**Keywords:- Beer, malt, Freekeh, Brewing, Beverages.**

## I. INTRODUCTION

Beer is one of the most consumed alcoholic beverage throughout the world. It is a fermented beverage made in several steps from malted barley. Other grains such as rice, teff and corn are also used to aid in the final texture and flavor of the product. It is commercially produced by the controlled fermentation of wort, nitrogenous compounds, liquids rich in sugars, trace elements and sulphur compounds extracted from malted barley. The process of beer is called Brewing. There are many types of strains of microorganisms used in brewing process like yeast and lactic bacteria, but the yeast strain Saccharomyces cerevisiae are used in it to be found and cheap. Normally, the brewing process includes treatment of grains, malting, mashing, filtration, fermentation and packaging. Malted barley, water, hops and yeast are the primary ingredients for making beer. Barley is one of the founder crops of ancient world agriculture and domesticated cereals. Malt is the product which comes from processed barley that has been stepped in water, germinating on malted drums, boxes or floors and later dried in kilns, under carefully controlled conditions. It is used as a basic raw material for beer and spirit, with much a lesser quantity is used in food industry.

Fig 1. Beer

The objectives of mashing are dissolution of grain components, grain cell wall structure breaks, starch extraction and hydrolysis, proteins, sugars and non starch polysaccharides and fermentable sugars are established. During fermentation stage, flavor,

alcohol level and carbonation level is established. At the end of fermentation, yeast flocculates and it can be easily seperated.

**1. FREEKEH:**

Freekeh is one of the ancient grain packed with fibers, calcium and proteins. It is a cereal made from green Durum wheat (Triticum turgidum) that is roasted and rubbed to make its flavor. Freekeh (pronounced free-kuh or free-kah).

According to food lore, Freekeh's fiery story dates back thousand of years, possibly as far back as 2300 BC. It became in middle eastern cuisines and mediterranean and has a part of food culture in many countries. It is also known as Frikeh, Frekeh, Farrik and green wheat. Compared to wheat, it contains high proteins and antioxidant levels.

Fig 2. Whole freekeh.

**2. Nutritional Benefits of Whole FREEKEH:**

- It has high protein and fiber content that assists to control weight and it stimulates healthy bowel movements.
- It has carotenoids such as lutein and zeaxanthin which acts as an antioxidant levels that prevents mascular degeneration.
- Freekeh assists digestive ailments such as diarrhoea, candida virus and leaky gut syndrome.
- Each serving of freekeh provides 2.25 grams of Glutamic acid.
- It is a good source of protein, fiber, iron, phosphorous, vitamins, manganese and magnesium.
- It is a plant based food with a low glycemic index, making a good choice for individuals, managing diabetes.
- Compare to wheat and Quinoa, it contains much higher antioxidant levels and high content of fructooligo saccharides and fructose rich polymers.

Table 1. Nutritional Values of FREEKEH.

| Energy | gms |
|---|---|
| Proteins | 7g |
| Carbohydrates | 33g |
| Fiber | 8g |
| Fat | 1.5g |
| Sugars | 1g |
| Calcium | 20mg |
| Iron | 1.8g |
| Magnesium | 40mg |

## II. METHODOLOGY

**1.Selection of Freekeh:**

Whole freekeh cereals are identified and selected. These whole freekeh cereals are sun dried and remove the unwanted portions.

**2. Germination or Malting:**

The malting process converts raw grain into malt. Freekeh is soaked in water for 24 hrs. Water is absorbed by the grain. The excess water is drained away and the Freekeh grains are incubated at 16-18℃ for 96 hrs to allow germination. Freekeh contains high amount of fiber content like barley.

So, if only Freekeh is used for production of beer. Germination is the process in which starch converted into maltose sugar. In germination time, mostly enzymes are activated which is favourable for beer production. Therefore, it should be diluted by adding malt adjunts and dextrose sugar syrup.

Fig 3. Germination

**3.Kilning (hot air):**

Kilning reduces the grain moisture content and stops germination. The germinated freekeh are killed by slow heating at 70℃ (minimum 40℃ , maximum 70℃). If the kilning temperature must above 70℃ , the produced beer will be darker in colour.

Fig 4. Kilning

**4.Deculming:**

Deculming removes malt culms in the final step of the malting process. TAS cleaning machine is also used in this method.

**5. Malt Cleaning:**

The malt is cleaned prior to mashing seives and to remove the dusts, lumps and stones in the malt. To remove any steel materials in the malt, magnet was used.

Fig 5. Malt cleaning.

**6. Milling:**

It is an important step in brewing process. The dried and cleaned Freekeh grains are grinded into a coarse powder with the help of Grinders or rollers.

Fig 6. Milling

**7. Mashing:**

It is the process of immersing the milled Freekeh in water. The aim of mashing is to create wort. Sugar in the milled freekeh in long chains which are unfermentable. This process allow extracting fermentable sugar from the malt.

Fig 7. Mashing

**8. Lautering / Filtration:**

It is a process in which the mash is separated into wort and the remaining residual grain.

**9.Wort Boiling:**

It is the process in which enzymes inactivates and remains protein is coagualted. The lautered wort is boiled with stirring for 2hrs.

And during wort boiling, hops are added for flavor, aroma and bitternessBoiling of wort.

Fig 8.Boiling of wort.

**10.Fermentation and Maturation:**

Once the wort is boiled, the yeast is added. The function of yeast is to ferment the wort and turns into a beer. In India, Saccharomyces calbergensis and Saccharomyces cerevisiae used but in a foreign countries, S.uvarum is preferred. S.cerevisiae is a top yeast whereas S.calbergensis and S. uvarum are bottom yeast. Now, Saccharomyces cerevisiae is used to make a Freekeh beer.

During this fermentation, yeast converts sugar mainly into ethanol and CO2 and some amount of glycerol.

Fermentation will take about usually 12-15 days to complete. Primary fermentation usually completes in 3-4 days. Fermentation temperature usually carried out 3-4° C. and ranges from 3-12° C. But fermentation temperature will vary depending on beer types.

Fig 9. Beer fermentation

For example, Ales are fermented above 19° C, a lager beer is fermented below 15° C. At the end of fermentation, the beer is chilled to 9° C and then 5℃ and kept to attend a maturation stage. Maturation usually around 19-21 days.Assimilation of yeast, precipitation of cold break, beer volatile washing by CO2 are the most important process in maturartion.

**11.Filtration and Finishing:**

The main purpose of filtration is to remove culture cells within the beer, because if the culture cells is migrate in beer, then it reduces the shelf life and quality and also creates oxidation. Whatman filter paper is used to filter the beer. It removes yeast, removing the beer crystal clear.The CO2 is adjusted in the BBT and it is ready to be packaged.

Fig. 10: Finishing & filtration

Fig. 11: Bottling

**12.Packaging and Storage:**

Beer is packed using kegs (used in industry ), cans, barrels and bottles (330ml glass bottles ). After bottling, it to be stored in dry place , cool (not freezing). For optimum shelf life , it to be stored at a temperature between 40-45° F.

Fig 12. Packaged beer.

## III. RESULTS & DISCUSSION

The present investigation entitled "Design and production of fiber enriched beer by optimizing freekeh into the Brewing process" was carried out. Alcohol content, fiber content, Water content, total sugars and pH was analyzed. Those results are shown in below.

Table 2.Results are show.

| Tests | Results |
|---|---|
| Alcohol content | 5.35% |
| Total sugars | 4.4% |
| PH | 4.6 |
| Water content | 77.61% |
| Fiber content<br>Total dietry fiber<br>Soluble dietry fiber | <br>2.0%<br>6.86% |


Fig 12. GraphicaL representation of % of alcohol

## IV. CONCLUSION

This study concludes that to maintain the quality of malt and beer and other beverage products. During this study, safety and sanitary conditions was followed strictly like grain receiving, mashing, milling, fermentation, filtration and packaging.

Barley beer includes health risks such as coordination loss, hypothermia, vomitting, diarhhoea, low blood sugars and controlling emotions. But Freekeh beer avoids these health risk.

This results shows that Freekeh beer has more essential nutrients and fiber content than the usual beer.

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