

The Integration of Flax Seed into Brewing and Production of Omega-3S Enriched Beer

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ABSTRACT

Brewing is a kind of art that should be done with passion and perfection. Brewing holds a longest history ever to look after. We all may aware that the most consumed and oldest brewing recipe is beer. Beer is nothing but a drink made of fermentation of starch rich barley in water which results in a sweet beverage with yeast. It provides most convincing and replenishing mouth feel. Beer processing being in process since 5000 BC. There were 'n' number of varieties or flavours of beer you can spend your leisure time with. Now We are likely to introduce flax seeds into brewing integral to add some extra nourishment to the world's favorite drink. Brewing of flax seeds after proper processing gives you a unique mouth feel rather than that of a regular beer provides to your taste buds flax seeds contain bag full of nutrients. They are loaded with Omega 3 fatty acids and with some major vitamins and minerals. Therefore brewing of flax seeds serves both on taste and on diet, now you don't need to cheat on your diet to have a tasty beer. Let's have a look over the processing of beer from nutritious flax seed.

KEYWORDS: Beer-flaxseeds-brewing-hobs-fermentation-starch-beverages-alcohol-temperature-barley-rice-tradition-neoethic-daily consumption-nutrition-refreshment

INTRODUCTION

Since early times beer production was in practice. Beer have the longest history among the traditional beverages. It was said to be in practice during the Neolithic period. The oldest beer was found in Mesopotamia in South West Asia. The age of the beer will be around 10000B. C. E. Therefore the arise of beer culture should be from Mesopotamia according to archeology. People around the world were always fond of beer. Different kinds of beer were existed during olden days. Any cereal containing sugar was used to ferment beers sugar produce alcoholic beverages during fermentation. Beers usually brewed in domestic scale which accounts to the need of the people. During the construction of the great pyramid of Giza, beer were distributed to labor as daily wages in a total of five to six liters per day. In Europe beer was produced with sweet fruits which would not rather called as beer now. In China beer was made with rice and other cereals rich in starch. Later improvisation in the recipe introduced barley into beer processing which made a huge impact. Even beer has a huge part in culture and tradition of people. It was served to their goddess called Ninkasi during summers in order to protect their recipe where only few of them were literate and had knowledge about brewing techniques. After the huge response for beer among the people it was commercialized during industrial revolution. And MNCs took beer processing a serious profitable sector and made premium beer which was appreciated by the consumers worldwide.

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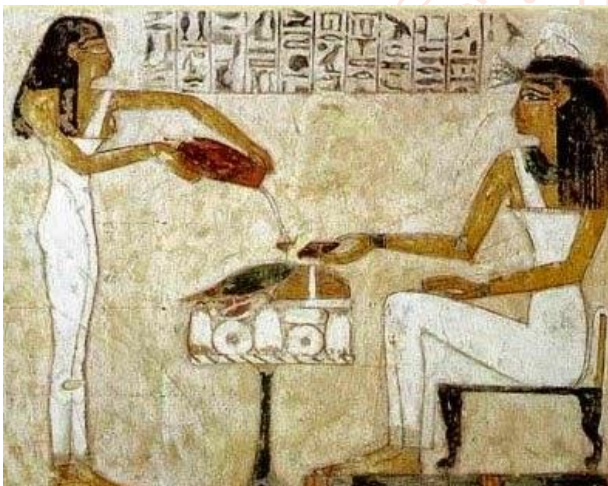
Traditional way of Brewing:

In the Museum's Egyptian galleries, you can see models excavated from tombs which show wooden figures of brewers straining mash through a cloth into ceramic vessels. This visual clue, alongside the research of Delwen Samuel, led us to use a two-stage mash, which we then left to ferment in a vessel containing a harvested yeast culture. The advantage of a two-stage mash is its simplicity. The cold

mash is made using ambient temperature water and a malted, ground grain. This mash will contain all the active enzymes required to convert starch to sugar. The second mash, which is processed at the same time, consists of ground, unmalted grain. This is mixed with hot water and further heated.

There is evidence of heat exposure on ceramic brewing vessels found in Egypt. It is unlikely that earthenware would be heated above 80 degrees (as it would compromise the material), so this was the temperature to which we heated the hot portion of the mash. Heating grain to this temperature allows the starches present to unravel, but kills the enzymes. By preparing the two mixtures separately and then combining them, both the accessible starches and the enzymes required to convert them are present in the final mix.

The hot mash and the cold mash were mixed together and left to cool, so that the enzymes could start to convert the starches in the grains to fermentable sugars. When cool, the mash was sieved of any residual grain, directly into the terracotta fermenting vessel, which had been pre-inoculated with a harvested yeast strain. More warm water was used to rinse remaining starches and sugars from the grains. The vessel was covered with a muslin cloth and left to ferment. The resulting beer would have been drunk while still actively fermenting from the ceramic vessel itself.



Nutritional assessment of flax seeds:

You may ask why flax seeds have been chosen by us. But you will be in wonder if you came to know the nutritional benefits of flax seeds. It has been called as a power plant which includes a wholesome of nutrients with it. Flax seeds

cultivation started over 3000 BC ago. Presently researchers came up with preliminary evidences to encourage the use of flax seeds by acknowledging its value. Now it has been seen in all foods from crackers to waffles. Then what, why can't we introduce such a beneficial seed into brewing. That made us intimated to introduce flax seeds into brewing. Because beer is something that has been loved by most of world. It has become a traditional and much needed drink during social gatherings. Let's have a look over the nutritional benefits of flax seeds.

- They are highly rich in Omega-3 essential fatty acids which have some extraordinary favourable benefits for an healthy heart. It has been said that each spoon of this power seed contains 1.8 grams of plant Omega -3s.
- It also contains lignans which have both plant estrogen and antioxidant qualities. It contains 75 to 800 times more lignans than any other plant foods. Lignans plays an significant role in prevention of breast cancer and osteoporosis. It has been identified as dietary tool for promoting health.
- They are rich in both soluble and insoluble dietary fibre. A tablespoon of flax seeds contains 3 grams of fibre which accounts upto 12% of daily fibre requirement. The estimated amount of soluble fibres present in flax seeds is 20-40% and whereas insoluble is 60 to 80%. this fibre duo gets fermented by the bacteria in the large bowel, bulks up stools and result in more regular bowel movements.
- Flax seeds reduces bad LDL cholesterol. Regular Consumption of flax seeds for 3 months significantly reduces bad cholesterol upto 20%. These effects are possible due to the fibre in flax seeds usually binds up with the bile salts and it is excreted by the body.
- Flax seeds have a natural ability to reduce or lower blood pressure. A Canadian study found that eating 30 grams of flax seeds daily for 6 months reasonably lowers systolic and diastolic blood pressure by 10 mm Hg and 7 mm Hg respectively. A 2 mmHg reduction in blood pressure can lower the risk of dying from stroke by 10% and from heart disease by 7%.
- Flax seeds are great source of plant protein. They are rich in arginine, aspartic acid and glutamic acid flax seed protein aids in improving immune system, lowering cholesterol, in prevention of tumors and had anti fungal properties with them.
- Due to the presence of insoluble fibre they control blood sugar level in a significant manner. Research has found that insoluble fibre slows down the release of sugar into the blood and reduces blood sugar.
- Flax seeds helps in weight control. They reduce the feeling of hunger and overall appetite and provides feeling of fullness. It keeps hunger at Bay.

BENEFITS OF FLAX SEEDS

- Great source of Omega-3
- Mood enhancing
- Great source of fiber
- Antioxidant rich
- Healthy heart
- Lowers blood pressure
- Healthy joints
- Healthy digestion
- Healthy hair
- Smoother skin
- Weight control
- Anti-aging
- Richest known source of lignans
- Healthy hormone balance
- Anti-inflammatory
- Immune boosting



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Nutrient chart of flax seeds:

Flax Seeds - Nutritional Facts per 100 g

Nutrients Mg Percentage

Omega 3	22,4 g	938%
Folates	87 µg	22%
Niacin	3.08 mg	19%
Pantothenic acid	0.985 mg	20%
Pyridoxine	0.473 mg	36%
Riboflavin	0.161 mg	12%
Thiamin	1.64 mg	137%
Vitamin A	0 IU	0%
Vitamin C	0.6 mg	1%
Vitamin E	19.95 mg	133%
Vitamin K	4.3 µg	3.5%
Sodium	30 mg	2%
Potassium	813 mg	17%
Calcium	255 mg	22.5%
Copper	1.12 mg	124%
Iron	5.73 mg	72%
Magnesium	392 mg	98%
Manganese	2.48 mg	108%
Zinc	4.34 mg	39%



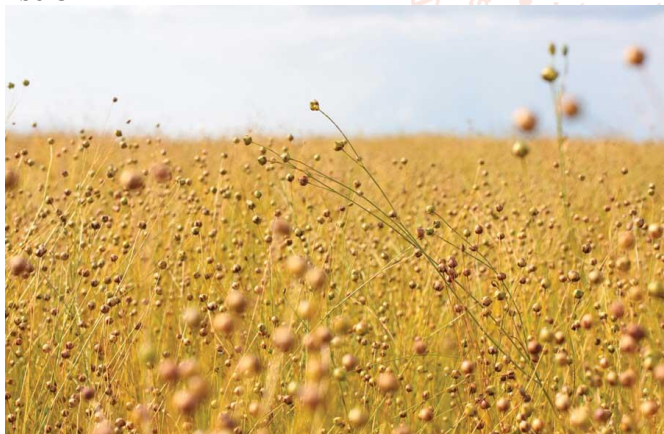
Kilning:

- The germinated seed are then killed by slow heating at 80° This process is called kilning.
- The kilning temperature must not harm amylase enzyme. Furthermore, if kilning temperature is higher, darker will be the beer produced.

Methodology:

Selection:

Well germinated whole flax seeds are identified and selected. These whole seeds are sun dried and sauted to remove the outer shell to get the benefits of both soluble and insoluble fibers.



Milling

- The dried flax seeds are then crushed between rollers to produced coarse powder called grist

Malting:

- Flax seeds are first cleaned and then soaked in water for about 2 days. Then excess water is drained away and the flax seeds are incubated for 4-5 days to allow germination
- The germination steps allow the formation of highly active α -amylase, β -amylase and proteases enzymes as well as various flavor and color components
- Flax seeds contains considerable amount of protein like barley. So, if only flax seed are used for beer production, the final beer will be dark and unstable. Therefore, protein present in malt should be diluted by adding additional starch or sugary materials.
- Such sugary or starchy materials are called malt adjuncts and includes dextrose sugar syrup.



Mashing:

- Grist is mixed with warm water and the resulting materials is maintained at 65°C for about 1 hour.
- In doing so, starch is hydrolyzed by amylase enzyme to produce single sugar, maltose, dextrose etc. similarly, protein is hydrolyzed by proteolytic enzymes into small fragments and amino acids.

- The degree of enzymatic hydrolysis is strongly depends on pH and temperature. β -amylase has optimum activity at temperature 57-65°C whereas α -amylase has optimum activity at temperature 70-75°
- The liquid obtained by mashing is called wort. The husks and other grains residue as well as precipitated proteins are removed filtration.



Boiling of wort:

- The filtrate is then boiled with stirring for 2-3 hours and hop flowers are added at various interval during boiling.
- Reasons for boiling of wort:
 - For extraction of hop flavor from hop flower
 - Boiling coagulate remaining protein and partially hydrolyze protein and help in removal of protein
 - Boiling inactivates enzymes that were active during mashing, otherwise causes caramelization of sugar
 - Boiling also sterilize and concentrate the wort



Fermentation:

- Beer production utilize strain of *Saccharomyces carlsbergens* and *S. varum* which are bottom yeast and *S. cerevisiae* which is a top yeast.
- Yeast cells for inoculation are usually recover from previous fermentation tank by treatment with phosphoric acid, tartaric acid or ammonium persulphate to reduce the pH and removed considerable bacterial contamination.
- Fermentation is usually carried out at 3-4 °C but it may range from 3- 14° Fermentation usually completes in 14 days.
- During fermentation yeast converts sugar mainly into ethanol and CO₂ plus some amount of glycerol and acetic acid.
- For fermentation open tank fermenter can be used however closed fermenter tank is preferred, so that CO₂ liberated during fermentation can be collected for later carbonation step.
- CO₂ evolution is maximum by fifth day of fermentation, there is no evolution of CO₂ by 7-9 days because yeast cells become inactive and flocculate.
- Most beer contains 3. 5-5% alcohol.

Addition of Hops:

- Hops are dried female flower of hop plant *Humulus lupulus*. Approximately one quarter pound of hop flower is added per barrel of beer and up to 2 pound per barrel of ale.
- Advantages of hop addition in beer are;
 - Provide beer with its pungent and aromatic character
 - Provide tannin which helps in coagulation of remaining protein
 - Contains α -resin and β -resin which gives bitter flavor as well as preservative action against gram Positive bacteria
 - Contains pectin which is responsible for foam characteristic of beer.



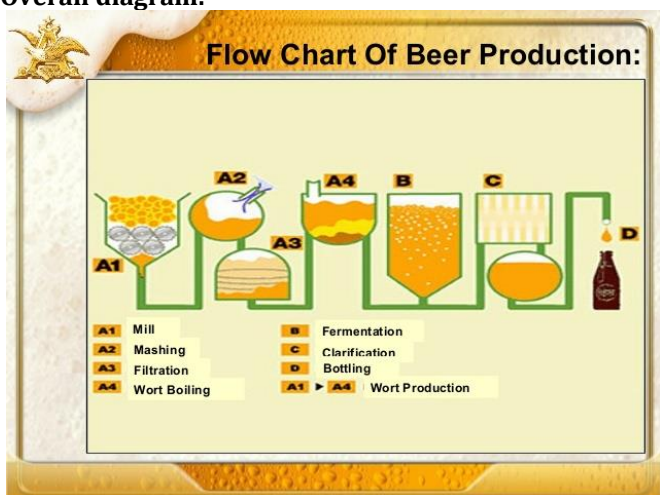


Finishing, Ageing, Maturation and Carbonation:

- The young and green beer is stored in vat at 0°C for several weeks to several months. During this period, precipitation of protein, yeast, resin and other undesirable substances take place and beer become clear.
- Ester and other compounds are also produced during ageing which gives taste and aroma.
- After ageing, the beer is carbonated by carbon dioxide of 0.45-0.52%.
- The beer is then cooled, clarified, filtered and packed in bottles, barrels and cans.



Overall diagram:



Merits of flax beer:

- The fermented flax seed helps in improving gut health. A study has shown that the fermentation of flaxseed fibers in the gut changes the micro biota to improve metabolic health, and could challenge obesity. Obviously we are using fermented flax seed in brewing which will simultaneously helps in maintaining healthy gut.
- Flax seeds are generally rich in omega 3 fatty acids which has heart healthy effects. And excessive consumption of this beer wouldn't affect your Health much than regular ones. omega 3s helps in maintaining heart's natural rhythm.
- Flax seeds are effective in reduction of bad LDL cholesterol and provides good cholesterol.
- Regular barley beer includes severe health risk such as flushing, confusion, trouble controlling emotions, blackouts, loss of coordination, seizures, drowsiness, trouble breathing, hypothermia, low blood sugar, vomiting, diarrhea, bleeding, irregular heartbeat, and others.
- Such severe health risks are avoided by flax seed beer. Flax seeds contains 'n' number of health beneficial nutrients and fibers bestowed with it. Therefore these side effects can be massively avoided by consuming our flax seed beer.
- Consumption of regular beer includes many disadvantages such as weight gain, fatigue, irregular sleep, increasing blood pressure, heart burn, liver damage etc. Such major drawbacks are heavily controlled in our flax seed



Conclusion:

Innovations in our daily essentials are much needed part of life. It improves our way of living. In the modern world which runs behind money and fame we eventually got no time to spend or look over our health. Artificial flavoring beverages and ready to eat foods are taking huge part in our daily routine. In order to save time on cooking and to have some delicious taste we need to sacrifice our health. One of such drink is beer. It accompanies every family gatherings and parties. Simultaneously it includes severe health risk. That's why we have developed a flax beer which exactly delivers you a feel of having a delicious beer at the same time it doesn't cost your health. Isn't sounds good??. Now you don't need sacrifice your health to have a chill with your loved ones. flax seeds beer nourishes both your taste buds and health as well as like a proverb says health is wealth.

Reference:

[1] Gaetano, G.; Costanzo, S.; Di Castelnuovo, A.; Badimon, L.; Bejko, D.; Alkerwi, A.; Chiva-Blanch, G.; Estruch, R.; La Vecchia, C.; Panico, S.; et al. Effect of moderate beer consumption on health and disease: A consensus

- document. *Nutr. Metab. Cardiovas.* 2016, 26, 443–467. [Google Scholar] [CrossRef] [PubMed]
- [2] Moura-Nunes, N.; Brito, T. C.; Fonseca, N. D.; de Aguiar, P. F.; Monteiro, M.; Perrone, D.; Torres, A. G. Phenolic compounds of Brazilian beers from different types and styles and application of chemometrics for modeling antioxidant capacity. *Food Chem.* 2016, 199, 105–113. [Google Scholar] [CrossRef] [PubMed]
- [3] Capece, A.; Romaniello, R.; Pietrafesa, A.; Siesto, G.; Pietrafesa, R.; Zambuto, M.; Romano, P. Use of *Saccharomyces cerevisiae* var. *boulardii* in co-fermentations with *S. cerevisiae* for the production of craft beers with potential healthy value-added. *Int. J. Food Microbiol.* 2018, 284, 22–30. [Google Scholar] [CrossRef]
- [4] Budroni, M.; Zara, G.; Ciani, M.; Comitini, F. *Saccharomyces* and Non-*Saccharomyces* Starter Yeasts. In *Brewing Technology*; Kanauchi, M., Ed.; Intechopen: London, UK, 2017; pp. 81–100. [Google Scholar]
- [5] Gómez-Corona, C.; Lelievre-Desmas, M.; Buendía, H. E. B.; Chollet, S.; Valentin, D. Craft beer representation amongst men in two different cultures. *Food Qual. Preferences* 2016, 53, 19–28. [Google Scholar] [CrossRef]
- [6] Estela-Escalante, W. D.; Rosales-Mendoza, S.; Moscosa-Santillán, M.; González-Ramírez, J. E. Evaluation of the fermentative potential of *Candida zemplinina* yeasts for craft beer fermentation. *J. Inst. Brew.* 2016, 122, 530–535. [Google Scholar] [CrossRef]
- [7] Giacalone, D.; Ribeiro, L. M.; Frost, M. B. Perception and description of premium beers by panels with different degrees of product expertise. *Beverages* 2016, 2, 5. [Google Scholar] [CrossRef]
- [8] Oladokun, O.; Tarrega, A.; James, S.; Smart, K.; Hort, J.; Cook, D. The impact of hop bitter acid and polyphenol profiles on the perceived bitterness of beer. *Food Chem.* 2016, 205, 212–220. [Google Scholar] [CrossRef] [PubMed][Green Version]
- [9] Juric, A.; Coric, N.; Odak, A.; Herceg, Z.; Tisma, M. Analysis of total polyphenols, bitterness and haze in pale and dark lager beers produced under different mashing and boiling conditions. *J. Inst. Brew.* 2015, 121, 541–547. [Google Scholar] [CrossRef][Green Version]
- [10] Piazzon, A.; Forte, M.; Nardini, M. Characterization of phenolics content and antioxidant activity of different beer types. *J. Agric. Food Chem.* 2010, 58, 10677–10683. [Google Scholar] [CrossRef]
- [11] Zhao, H.; Li, H.; Sun, G.; Yang, B.; Zhao, M. Assessment of endogenous antioxidative compounds and antioxidant activities of lager beers. *J. Sci. Food Agric.* 2013, 93, 910–917. [Google Scholar] [CrossRef]
- [12] Quifer-Rada, P.; Vallverdú-Queralt, A.; Martínez-Huélamo, M.; Chiva-Blanch, G.; Jáuregui, O.; Estruch, R.; Lamuela-Raventós, R. A comprehensive characterisation of beer polyphenols by high-resolution mass spectrometry (LC-ESI-LTQ-Orbitrap-MS). *Food Chem.* 2015, 169, 336–343. [Google Scholar] [CrossRef] [PubMed]
- [13] Aquilani, B.; Laureti, T.; Poponi, S.; Secondi, L. Beer choice and consumption determinants when craft beers are tasted: An exploratory study of consumer preferences. *Food Qual. Preferences* 2015, 41, 214–224. [Google Scholar] [CrossRef]
- [14] Ferreira, R. H.; Vasconcelos, R. L.; Judice, V. M. M.; Neves, J. T. R. Inovação na fabricação de cervejas especiais na região de Belo Horizonte. *Perspect. Ciênc. Inf.* 2011, 16, 171–191. [Google Scholar] [CrossRef][Green Version]