“DEVELOPMENT OF MALT POWDER– IRON –FOLIC ACID RICH PRODUCT”

PROJECT WORK
SUBMITTED TO DEPARTMENT OF PG STUDIES IN FOOD SCIENCE AND NUTRITION,
BESANT WOMEN’S COLLEGE, MANGALORE

IN THE PARTIAL FULFILMENT OF REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN FOOD SCIENCE AND NUTRITION

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CERTIFICATE

This is to certify that the project work entitled ***"DEVELOPMENT OF MALT POWDER– IRON –FOLIC ACID RICH PRODUCT"*** is an authentic record of independent research work done by ***Ms.*** **AMNA NASMI** ***(Reg.no:193041962)*** under my supervision during the period of **April 2021 to OCTOBER 2021**, submitted to Mangalore university for the partial fulfillment for the award of the degree of ***Master Of Science In Food Science And Nutrition*** and the present work has not been previously formed the basis for the award of degree, diploma, fellowship, associateship or other titles.

Place: PUMPWELL, MANGALORE
DATE: 30 OCTOBER 2021

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CERTIFICATE

This is to certify that the project work entitled ***"DEVELOPMENT OF MALT POWDER– IRON –FOLIC ACID RICH PRODUCT"***, submitted to the ***Department of PG Studies in Food Science and Nutrition, by Ms.*** **AMNA NASMI** ***(Reg.no:193041962)*** towards the partial fulfillment of the degree of ***Master Of Science In Food Science And Nutrition***, is a faithful record of original work carried out by her in the academic year ***2020-2021.***

Place: PUMPWELL, MANGALORE
DATE: 30 OCTOBER 2021

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EXAMINERS:

1.

2.

DECLARATION

I, ***AMNA NASMI,*** hereby declare that project work entitled ***"DEVELOPMENT OF MALT POWDER– IRON –FOLIC ACID RICH PRODUCT"*** , is a bona fide record of research work done by me under the supervision of ***Mrs. SHWETA SINGH,*** **Assistant professor , Department of PG Studies In Food Science and Nutrition, Besant Women's College, Mangalore.**

The information depicted in the current report is the result of my own work, except where the reference is made. The information provided in the report is authentic as per my knowledge.

The results embodied in the project work have not been submitted to any other university or institution for the award of any degree, diploma, associateship, fellowship or similar titles.

Place: PUMPWELL, MANGALORE
DATE: 30 OCTOBER 2021

AMNA NASMI

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ABSTRACT

Iron deficiency anaemia and Neural Birth Defects is very commonly seen in pregnant ladies. It is because of micronutrient deficiencies especially iron and folic acid. Consumption and supplementation of both these vitamins is important to overcome these defects. Thus developing a product which contains both these vitamins will help cope up this problem. The iron and folic acid which is the major component of product standardization claims that three variations of the product was further taken to a sensory evaluation in order to select the best proportion for malt powder based on consumer preference. The nutrient content estimation claimed that the malt powder is rich in folic acid (81.15 mcg), iron (32 mcg), moisture (1.28g) and fibre (2.73 g). The shelf life was based on the sensory evaluation claiming to have a shelf life of 3 months and above.

CHAPTER 1

INTRODUCTION

In India, NTDs and iron deficiency is said to be most commonly seen in pregnant ladies. Several parts of India have experienced very low weight babies, premature births etc. These are seen as a result of very low consumption of iron during pregnancy. In some parts of the country, many females, and also males have no knowledge about the importance of consumption of folic acid before pregnancy as per the surveys conducted by the researchers. NTDs are seen when there is no folic acid for the development of skull and spinal cord of the fetus. However, with the help of new techniques and different programs it is more known to all parts of the country, state the importance of supplementation of iron and folic acid before and during pregnancy.

1.0 INTRODUCTION

1.1 NEURAL BIRTH DEFECT

Neural birth defeat is said to be most commonly seen birth defect in India. Several studies were conducted to determine the incidence of neural tube defects in India. Damage to the spine, spinal cord and brain is neural tube defects which occurs during the initial stage of pregnancy or pre – pregnancy. Spina bifida and anencephaly are known as the most common type of neural birth defects.

1.1 a) CLASSIFICATION

Neural Birth Defects are mainly classified into 2 types I.e,

- Cranial dysraphism which is nothing but destruction of cranial neural tube closure and
- Spinal dysraphism which is nothing but destruction of caudal neuropore closure

The term dysraphism shows purposeful progression between neural ectoderm to the posterior and cutaneous ectoderm. Neural birth defects can be midline defects, ventral or dorsal. Some are classified into open where congenital skin defect is seen and some are classified into closed in which skin is covered.

There is something known as Craniorachischisis which is an unusual form, which is seen when neural tube closure is failed to the overall body axis

1. Cranial dysraphism

− Under Cranial Dysraphism 2 types of defects are seen namely Anencephaly and Encephaloceles

− Cranial dysraphism is a condition seen during pregnancy, where a large area of the brain and skull of the fetus is destroyed or is not seen

- Anencephaly

− A very large part of the skull is absent in this condition
− Babies that are born with this condition are still born and their chances of survival is very low usually only till few hours or days
− Condition when the head end or cephalic end of the neural tube fails to close
− Cranium bifida is the benign form.

• Encephaloceles

− During the development of the foetus, when neural tube fails to close completely, it gives birth to a condition known as encephaloceles
− Sac like formation is seen because of the gap that is created is between cerebral spinal fluid, brain tissue and meninges

2. Spinal Dysraphism

− Refers to a group of defects that affects spine, spinal cord or nerve roots
− In this condition, complete closure of spinal cord is not seen
− There are different types of spinal dysraphism that is seen in the fetus which includes myelomeningocele which is often called as spinal bifida Aperta or open spinal bifida. In this condition the spinal cord and their membranes are not seen within their spinal column, but they are extended to a sac outside of the body.
− Spina bifida occulta – in this condition the spinal cord and their membranes are not affected but there is a defect in the bones of the spinal cord
− Spinal cord malformation or diastematomyelia- In this condition spinal cords are split into different cords.
− Spinal cord lipoma- A larger growth of fat is seen which is attached to spinal cord their membranes and outside of the spinal cord
− Dermal sinus tract is part of the skin that can reach to spinal cord
− Benign – cysts and tumors found with types of spinal dysraphism
− Tethered Cord- A condition which occurs as a result of different types of condition.

1.1 b) Causes

There are numerous factors that lead to neural tube defects, but folic acid deficiency during pregnancy is known to be the most important factors that causes this disease. Some of the other factors which include genetics, environmental, nutritional and obesity.

1.2 **Anemia** in **Pregnancy**

The normal level is 11 gm% as per WHO during pregnancy. A small cutback in the hb level below the given bb level leads to anemia in pregnant ladies. In India around 40-80% of incidence of anemia is seen especially in pregnant ladies. There are different types of anemia that is seen during pregnancy because of several different factors like iron deficiency, folic acid deficiency, vitamin B12 deficiency or protein deficiency. Anaemia can also be caused because of hereditary factors of bone marrow insufficiency. Chronic condition in pregnant ladies can also cause anemia.

During the second half pregnancy there is an increased demand of iron, which cannot be completely provided by diet, thus the deficiency of iron is seen during pregnancy. If this is not overcome, there is a high chance that it will lead to severe complications like heart failures, preterm labor, uterine inertia, cardiac failure and shock. Intra uterine is seen because of the deficiency iron in pregnant

1.2a) Megaloblastic Anemia

It is a condition where immature red blood cells are produced by bone marrow. It is mainly caused because of deficiency of vitamin B12 or folate or both. Deficiency of vitamin B12 is rarely seen in pregnant ladies, whereas folic acid deficiency is more commonly seen during pregnancy

1.3 How can we overcome neural tube defect and iron deficiency anemia in pregnant ladies?

As we all know neural tube defect is a condition where a fetus is born with an abnormal development or no development of brain and spine. During pregnancy there is a

high demand of iron reserves to our body that is not sufficiently provided by the diet, this leads to iron deficiency anemia in pregnant ladies. It is very important during pregnancy you get enough iron. For that reason, iron rich diet is recommended during pregnancy along with vitamin C to absorb more iron. During pregnancy doctors usually recommend 27 mg of iron a day. This can prevent the occurrence of premature births, postpartum depression, low body weight etc.

1.4 • Jaggery

Concentrated sugarcane juice is boiled until it completely changes to solid taste to produce tons and tons of jaggery. There are several different types of jaggeries in different parts of our country. They are palm jaggery, sugarcane jaggery, date palm jaggery, toddy palm jaggery etc. Consumption of jaggery has increased and its enormous health benefits become the reason for it. From digestion to detoxification, jaggery has an excellent role to play etc.

In India, an increased production of jaggery is seen and 90% of total production of jaggery is seen in India. Jaggery is rich in iron, calcium, as well as minerals like magnesium, potassium, zinc etc

1.4 a) Why is powdered jaggery better than solid jaggery?

In many rural areas powdered jaggery is especially used as a sweetening agent. Powdered jaggery is manufactured by maintaining a temperature range between 120 and 122c. It has a high rate of moisture evaporation and cooling rate because of its action and spoilage of jaggery usually happens because of its moisture content. Powdered jaggery has very low moisture content and hence the chances of spoilage is very less. They also have an increased shelf life or can be stored about 6 months or longer.

1.4 b) Jaggery to prevent Anemia

During pregnancy, there is a high demand for iron since it helps in the transportation of oxygen to mother as well as the fetus. It helps in the production of WBC, RBC in the fetus and hence iron should be taken daily. Jaggery is rich in iron and hence helps overcome

their problem. It helps in replacing iron to prevent iron deficiency in pregnant ladies. High potassium content in jaggery helps in reducing water retention. It is also known to help in breast feeding and offers nourishment to the fetus in pregnancy and even after the baby is born

1.5

• Peanuts

Arachis hypogaea or peanuts belong to Fabaceae family and are consumed in different forms like oil from peanuts, boiled peanuts, roasted peanuts or added peanut meal as snacks. It is mainly used for the production of oil and is rich in nutrients like folic acid, fibers, proteins, antioxidants and minerals. Peanut butter which is in trend now is made of thick paste which is used in different ways since it is high in nutrients, especially protein and vitamin B6. Peanuts have high content of MUFA which helps to delay the aging process.

1.5 a) Roasted peanuts

Roasting is a necessary process which depends on temperature that further causes different changes to the form of food like change in texture, color and also the appearance of the food products. Peanuts is roasted to increase the nutrient content. Itprevents nutrient loss and also helps to remove undesirable bacteria, allergies etc. Roasted peanuts are a good source of folate. Folate and folic acid are one of those nutrients which is important during pregnancy as it prevents birth defects like neural tube defects and premature births.

1.5 b) Peanuts during pregnancy

Folic acid is recommended during pregnancy to prevent the baby from birth defects like neural defects. Neural tube defects are seen as a result of deficiency of folic acid. Peanuts are rich in folate or folic acid.

1.6) • Ragi

− Health benefits

− In pregnant ladies

Ragi is called as finger millet. It is a very famous nutrient rich millet which is mainly seen in the southern region of India. Its scientific name is Eleusone Coracana and its appearance is similar to mustard seeds. It is used as a whole as well as powdered into fine particles to prepare various food products. It is extremely nutritious as it is high in protein, iron, fiber and calcium. The consumption of ragi has increased with time because of its health benefits like helps to reduce weight, act as antioxidant, and helping in the transportation of oxygen. The high calcium content helps in maintaining the structure of the bone and teeth and helps to prevent osteoporosis. It is also used in diabetic patients since it has good fiber content. Patients with low hb level or anemic patients are asked to include iron rich food in their diet, and ragi can be used for it. Apart from that is also known to reduce weight. Its high dietary fiber content gives a feeling of fullness and reduces unwanted binging.

1.6 a) In pregnant ladies

It is highly recommended to include ragi in the daily diet of pregnant ladies. For the healthy development of teeth and bones in the child. It is important that the mother consumes diet which is rich in calcium. Ragi has some amount of natural fats which helps to fight against heart disease, diabetes and hypertension. Anemia is one major disease seen in pregnant ladies thus it is important that the mother consumes high amounts of iron for the development of RBC in the fetus. Ragi is rich in iron that prevents anemia in mother and child as well. Ragi is also known to release stress. It also helps to overcome gestational anemia.

1.7 • Folic Acid

Folic acid is a B. complex, synthetic, water soluble vitamins which helps our body to produce new healthy cells. It is also called as human mode version of plate which is vitamin B9. They are naturally present in food and sometimes they are also added to some cereals, breads, flour, crackers, cookies, or bakery items. Some foods are rich in folate, they include green leafy vegetables like broccoli, lettuce, spinach, fruit like melons, lemons and bananas, mushrooms, meat like (especially like beef kidney and liver), tomato and orange juice. Folic acid hasseveral health benefits including the prevention and treatment

of low hemoglobin and increased hemoglobin level of pregnant women . They are also used to treat other conditions like stroke, depression, etc. Folic acid is very important for the proper functions of the human body and for the productor of DNA

1.7 a) Importance of Folic Acid during pregnancy

Folic acid or folic acid supplements are highly recommended or are advised by doctor to prevent ladies or women who is going to become pregnant. These are advised to prevent miscarriage or neural birth defects. If there is enough supplementation of folic acid, there is a very low chance of getting spina bifida. It is also important for the development of the proper organs in the baby.

CHAPTER 2

REVIEW OF LITERATURE

Developing a new product is a complex process. This requires knowledge of ingredients, processing methods, consumer demands and preferences etc. Having knowledge of these aspects helps one to make the right decision. This study focuses on developing a malt powder which is iron folic rich product . In this study, peanut ,jaggery and ragi flour have been used as the base because these shows iron folic rich properties. Review of available literature provides the foundation for the product development process.

2.0 REVIEW OF LITERATURE

***Fernando E. Viteri and Jacques Berger et* al, (2016)** examined the importance of Folic acid and iron supplementation during pregnancy and wrote an article titled "Importance of Pre-pregnancy and Pregnancy Iron status: Can Long Term Weekly Preventive Iron and Folic Acid Supplementation Achieve Desirable and Safe Status?" The most explanation for iron deficiency during pregnancy is caused since women worldwide step into pregnancy without an adequate amount of iron reserves. During the last two trimesters, demand for absorbed iron to beat moderate anemia is estimated in pregnant ladies. Programs should be organized to produce education among pregnant ladies on Iron-Folic supplementation. Ectoderm defects and hyper-homocysteinemia may also be prevented by long-tern weekly iron-folic supplementation to non-pregnant women. Thus, they conclude weekly supplementation of iron-folic acid both in pregnancy and pre-pregnancy can improve iron reserves safety and effectively, thereby promoting safe and other pregnancy.

***Chander Shekhar Gautam et* al, (2008)** described in their article that jaggery helps to purify blood and breast milk, also functions nourishment to the body during pregnancy and even after the baby is born. It is rich in iron, calcium thereby preventing the risk of Iron Deficiency Anaemia in pregnant ladies yet as in fetus. Potassium present in jaggery helps in stabilizing electrolytic balance within and fights edema. Jaggery also has several antioxidants which have a task in supporting the system and treat illnesses such as cold and flu. However, it can increase the calorie count and result in weight gain also could raise blood sugar levels, and results in Gestational Diabetes.

***Pankaj Verma, Narendra G. Shah, Sanjay M. Mahajani et al,* (2019),** experimented to check why powdered jaggery is more stable than solid blocks. In their experiment, they compared solid jaggery with powder jaggery supported properties like crystal size,

crystallinity, sorption isotherm, and also period. Powder jaggery showed higher heat of melting than that of solid jaggery blocks. There was a major difference observed within the equilibrium moisture content from the sorption isotherm of solid and powder jaggery. They performed X-Ray Diffraction for the intensity count of the jaggery. Intensity count and area under the curve in diffraction was higher for powder jaggery samples. From these analyses and measurements, they concluded that powdered jaggery was more stable and crystalline compared to solid jaggery and they get equilibrated at lower moisture compared to solid jaggery block. They also found that the additional stirring involved in making jaggery powder leads to a rise in crystallinity, hence we are able to conclude jaggery powder is more stable even under severe storage conditions.

***Yashasvi* (2020)** in her article mentions the big health benefits of jaggery during pregnancy. Jaggery due to its rich source of iron helps in improving Red Blood Cells count thereby preventing the danger of anemia. It even boosts the e system and provides a second source of energy. Excellent source of potassium of jaggery helps maintain water retention and thus monitor weight during pregnancy. Jaggery also helps to stop oedema. Low sodium content helps maintain vital sign which successively reduces the possibility of other kidney and heart related diseases. Eating jaggery in pregnancy enhances the functioning of the systema digestorium by promoting the secretion of digestive enzymes, thereby reducing the chance of indigestion, flatulence, intestinal worms, and other digestive disorders. It also eases bowel movements and prevents constipation. Low levels of vitamins and minerals in jaggery cure bone-related and joint stiffness problems.

Shweta Deotale, MG Bhotmange, Prabodh Halde, and M Chitale et al, (*2019*) experimented on different kinds of jaggery to check the storage behavior of every type thoroughly. To review the effect of storage they conducted Total Viable Bacterial Count and Viable Yeast and Mould Count of various kinds of jaggery sample. From the results obtained during their experiment, they concluded that coldness helps to increase the period of time of every kind of jaggery with none addition of preservatives. This prevents losses during storage.

***K Kalaivani et al., (*2009)** states in her article that anaemia is one amongst the explanation for maternal death in India because the prevalence of anaemia is higher during pregnancy. It's seen in both urban and rural areas. A number of the explanations maybe inadequate dietary iron, folate intake because of low vegetable consumption or low B12 intake, and poor bioavailability of dietary iron, thanks to the inhibitors present in phytate rich Indian diets. Chronic blood loss and increased requirement of iron also contribute to the upper prevalence in specific groups. Effective management of anaemia in pregnancy and early detection can reduce maternal mortality. Maternal anaemia is additionally related to poor intrauterine growth and increased risk of preterm births and low birth weight rates, leads to higher perinatal morbidity and mortality and better mortality rate.

***James A Greenberg, Stacey J Bell, Yong Guan, and Yan-HongYu et al.,* (2011)** in their article, review the metabolism of folacin, appropriate use of B complex vitamin supplementation during pregnancy, and benefits of vitamin B. They also discuss the advantage of supplementation of L-methyl folate which helps to stop pregnancy-related complications apart from ectoderm defects. B vitamin is one in every of the potential nutrients required for replication of DNA and as a substrate for big enzymatic reactions involved in amino alkanoic acid synthesis and metabolism of vitamins. During pregnancy need for Vitamin B complex increases because it's also required for the expansion and development of the fetus. Pteroylglutamic acid deficiency is related to abnormalities in mothers like Iron Deficiency Anaemia, Peripheral Neuropathy, and foetuses like Congenital abnormalities including exoderm and congenital heart defects. A number of recent data suggest that dietary B complex supplementation is nice for all reproductive-aged women.

Riedar MJ et al., (*1994*) explains in his article the prevention of ectoderm defect with periconceptional vitamin B complex supplements are related to a discount in risk for first

occurrences of Neural tube defects and for the re-occurrences of Ectoblast defects among women who are affected in their previous pregnancy. Vitamin B complex supplementation offers only the population in danger, fortification of food offers the advantage of ensuring evidence in virtually all of the population in danger. Supplementation of periconceptional folic acid can reduce, but not completely disable the occurrence of ectoderm defects.

***Simona Potzsch, Jana Hoyer and Schuschke, Manuersa Seeling, and Volker Steinbicker et al., (*2006)** surveyed "Knowledge among tykes about pteroylmonoglutamic acidand its importance during Pregnancy, a survey within the Federal State of Saxony-Anhalt (Germany). They set some standardized questionnaires regarding B complex vitamin and its importance in pregnant ladies to 33 schools in Germany. A complete of 4372 kids aged between 15-21 years attended the survey. 61% were girls and 39% were boys. To their surprise, only 61% heard about B complex vitamin, among that only 5% knew that it is a micronutrient or vitamin and 0.7% were conscious of its physiological functions in our body. 22% of the kids answered that vitamin B c must be taken during pregnancy. From their survey they concluded that the amount of awareness on how important Vitamin B complex is was shockingly low, therefore they suggest that the importance of B vitamin should be included in Biology to spread knowledge, among young adults, to stop congenital malformations, which mainly includes Ectoblast defects.

***R.S Barbour, M Macleod, G. Mirer, A.S Anderson et al., (*2011)** analysed in his survey the importance of folate supplementation before and through pregnancy. Uptake of 400 mcg B vitamin is suggested to any or all women who is pregnant or be sitting be one, to scale back the danger of exoderm defects within the fetus. In line with current guidance 400mcg vitamin B complex should be taken before conception and also till the 12^{th} week of pregnancy. This study explains why women decided to require the folate supplement. The tactic wants to explain this was a Spotlight Discussion where women were asked to affix to answer the questionnaires set by the clinic. From this discussion they concluded that 67% of ladies take vitamin B complex supplementation as recommended, 15% take it only during pregnancy, 18% only occasionally and 26% did not take B complex vitamin in

any respect. Eight Focus Group Discussions were organized with 24 participants. This study helped them to spotlight the importance of uptake of daily folate supplements and extremity of ectoblast defects.

Shalini S. Arya, Akshata R. Salve and S Chauhan et al., (*2016*) described peanuts as one of the functional diets. Peanuts have functional compounds like fibers, proteins, polyphenols, antioxidants, vitamins, and minerals which might be used as a primary ingredient for several forms of snacks and processed foods. There are abundant compounds like phenolic acids resveratrol, flavonoids, and phytosterols which help to dam the cholesterol absorption from the diet. These bioactive compounds are known for his/her disease preventive properties and to push a healthier lifestyle. Boiling and roasting of peanuts showed to extend within the concentrations of those bioactive compounds. Peanuts are an abundant source of folate or vitamin B complex which is one in every of the important micronutrients during pregnancy and infancy, to stop exoderm defects and within the production and maintenance of the cells. In India, it's utilized and peanuts allergies are comparatively less seen.

Rabiatu Bonku, Jianmei Yu et al., (*2020*) explained "Health aspects of peanuts as an outcome of its chemical composition" in her article. Peanuts are known for his/her high nutritional value and their distinctive and pleasant flavour especially afterthey are roasted or boiled, It's several health benefits like prevention of cardiovascular heart diseases, kidney stones, and also diabetes. It also has some effect on hypertension, inflammation, and even cancer. One in all the micronutrient folates is incredibly important in both pregnancy and infancy as because it helps within the maintenance and production of the cells. Peanuts usually undergo processing like roasting, boiling which not only enhance their flavor and color but also helps to forestall the bacterial load and aflatoxin

producingfungi. Nutritive value is improved by subjecting them to post-harvest technologies like nutrient fortification, chemical, physical and enzymatic modification.

Farheen Khan et al., **(2019)** portray the superb combination of jaggery and peanuts. Jaggery and peanuts can be combined to create some nutritious snack which isn't only delicious but is additionally healthy due of the nutrients like folate, calcium present in them. B Vitamin complex and calcium are especially important for pregnant ladies till 9 months to fulfildaily doses of Vitamin B complex and calcium for the prevention of exoderm defects and iron deficiency anemia. It also overcomes bone problems and helps to extend the body's system. A number of the foremost benefits of peanuts and jaggery include prevention of anemia, prevents cold-like flu, helps to ease menstrual pain, acts as a blood purifier, acts as an immune booster, prevents constipation, detoxifies the liver, good for the stomach, controls vital sign, helps in losingweight, an honest source of energy.

Kirk A Bol, Julianne S Collins, and Russell S Kirby et al., **(2006*)*** conducted studies to determine if folic acid fortification helped overcome the survival rate among infants born with Encephalocele and Spina bifida also to understand its effects during pregnancy and after birth. Pre-conceptional and periconceptional intake of folic acid help to prevent neural tube defects. In the United States introduction of colic, acid fortification decreased the occurrence of neural tube defects. A study named Retrospective Cohort was conducted with infants suffering from both Spina bifida and Encephalocele to check for the first-year survival rates. The first-year survival rate of infants with spina bifida was 92%, when the folic acid fortification was mandatory, as compared to those born before fortification. Even in the case of encephalocele, there was an increase in survival rates during folic acid fortification. This study indicates the importance of folic acid supplementation during pregnancy to reduce neural tube defects.

***MM Werler, S Shapiro, and AA Mitchell et a.l, (*1993)** designed a case-control study to learn if neural tube defects can be prevented by daily intake of 4 mg folic acid before and during pregnancy. It was conducted in tertiary and birth hospitals in the localities of Boston. This study included mothers of existence cases with neural tube defects and mothers of controls with some other major defects. The occurrence of the use of folic acid was compared among these two categories. The above findings suggest that daily intake of 0.4 mg of folic acid helps to prevent the occurrence of neural tube defects by 60%, moderately higher amount of folate will also reduce the risk of neural tube defects.

***Luz Maria De-Regil, Ana C Fernandez-Gaxiola, Therese Dowswell, and Juana Pablo Pena-Rosas et al., (*2010**) collected several data which included 6105 women with and without a history of pregnancy affected by neural tube defects. It was conducted to study if folic acid supplements should be taken before or during pregnancy to prevent the defects. From their data and analysis, they concluded that folic acid when taken before or during pregnancy, alone or in combination with other vitamins and minerals prevents only neural tube defects, since there is no statistically significant evidence in curing other birth defects like cleft lip, cleft palate, miscarriages, and congenital cardiovascular defects.

***Llamas Centeno M and Miguelez Lago C et a.l, (*2016)** in their article, bring out the importance of folic acid for the prevention of neural tube defects, by considering the current situation and its effects on future generations. Exposure to biological toxic agents like chemical or physical as well as deficiency disorders, some genetic malformations and conditions like obesity, diabetes, hyperthermia, and some unknown causes are some of the common factors that can lead to congenital malformations of the nervous system i.e., neural tube defects. These factors when they interfere with the metabolism of folic acid caused neural tube defects, which in turn causes abortions, stillbirths, or some serious newborn injuries that lead to poor quality of life, disability, etc. They put forward clear evidence where the occurrence of spina bifida is reduced after the consumption of folic

acid.\ Hence in more than 40 different countries, they introduced a new technology of fortifying folate with floor to reduce the risk of neural tube defects.

Blencowe H, Cousens S, Modell B, and Lawn J et al., **(2010*)*** conclude in their article that supplementation and fortification of folic acid both are effective to prevent neonatal mortality from neural tube defects. Even though neural tube defects have high mortality and morbidity they are preventable by the consumption of folic acid. There was a reduction in neural tube defects after the supplementation and fortification of folic acid in high-income countries, but there is no clear evidence of the reduction of neural tube defects in low-income countries. In their data analysis, they put forward the evidence for the effect of supplementation or fortification of folic acid in neonatal mortality. Using GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) methodology they conducted reviews, data meeting inclusion criteria, and evidence quality. Meta-analysis was performed and it showed a 70% reduction in secondary prevention of neural tube defects. Primary prevention of neural tube defects was obtained by combining three cohort studies with one Randomized Controlled Trials (RCT) and it showed a 62% reduction. 13% reduction was seen in low-income countries after the fortification and supplementation of folic acid. Thus, they state that neural tube defects can be approximately halved in low-income countries if folic acid fortification achieved complete population coverage.

Catherine Hoyo, Amy P Murtha, and Susan K Murphy et al., **(2011*)*** conducted data analysis with 539 pregnant women who were asked to consume folic acid above the recommended Tolerable Upper Limit (TUL). Bioavailability of folic acid is higher when they are fortified compared to naturally occurring folate in food. They conducted this survey to detect if there are any genetic defects if folic acid is given above the required amount. 51% of women started taking folic acid before pregnancy and 66% of women started taking it during pregnancy. Caucasian women were found to consume folic acid higher than the TUL during pregnancy, compared to African-Americans from their data.

They concluded that there is no known effect on humans when folic acid is taken above the Tolerable Upper Limit (TUL).

A E Czeizel and I Dudas et al., **(1992)** in their experiment assigned all the women planning pregnancy either to consume a single tablet of a vitamin supplement which consists of 12 vitamins, 0.8 mg of folic acid, 4 minerals, and 3 trace elements or a trace-element supplement which had copper, manganese, zinc and a small dose of vitamin C regularly for one month before conception till they missed their second menstrual period or later. Women taking folic acid were less prone to neural tube defects. 2104 women who were asked to take vitamin supplement were less prone to congenital malformations whereas 2502 women who were assigned to have trace element supplement had high chances oof congenital malformations. 6 cases of neural tube defects were recorded in women who consumed trace element, whereas no cases of neural tube defects were found in the vitamin supplement group. Thus, they concluded that the chances of first occurrences of neural tube defects are decreased by periconceptional vitamin use.

Christian Breymann et al., (**2015)** briefly explain how anemia is caused during pregnancy. Anemia is mostly seen in perinatal and obstetrics. Hemoglobin level decreases in our body and leads to anemia. Some of the major causes of iron deficiency anemia could be mainly nutritional deficiencies, bacterial or parasitical diseases, or Thalassemia. Gastrointestinal bleedings, peripartum blood loss, or uterine or placental bleedings are some of the major factors that can worsen iron deficiency anemia in pregnant ladies. Both pregnant ladies and fetuses are at high risks as it can lead to intrauterine growth retardation, fetoplacental miss ratio, premature and peripartum blood transfusion apart from the general risks of anemia. However, researchers have found several ways to overcome this condition by oral iron or intravenous iron preparations.

Lindsay H Allen et al., (**2000*****)*** describes the effect of iron deficiency in pregnant ladies as well as the fetus. Iron should be taken in excess amount before entering pregnancy to

improve the iron status of the mother. If the iron status of the mother is maintained then there is enough iron transportation to the fetus. The low birth weight of the infant or preterm delivery is also due to the insufficient storage or consumption of iron. Even when there is sufficient iron storage in pregnant ladies, iron supplements help overcome the iron status for a longer time, thus protecting from iron deficiency anemia.

Gian Carlo Di Renzo, Filippo Spano, and Irene Giardine et al., (*2015*) in their article highlight the importance of iron to prevent iron deficiency anemia especially in industrialized countries and countries with poor resources. Knowledge about anemia and its deficiency is quite low and hence it is important to bring out some of the beneficial effects of iron and iron supplements. Folic acid, iron deficiency including some other micronutrient deficiencies could be a major cause of iron deficiency anemia in pregnant ladies which in turn can cause some serious damage to the mother as well as the fetus. Preterm delivery and low birth weight is the most common and dangerous to the fetus it is very important to treat anemia in the first stage to prevent severe symptoms and diseases. If iron deficiency anemia can be treated in an early stage, it can prevent fetal-maternal mortality and morbidity. Bacterial and parasitic infections could also alter the absorption of iron thereby leading to severe gastrointestinal damage, therefore, it should be diagnosed and treated at earlier stages. Supplementation of iron is done either through the oral route or intravenous. Usually, oral ferrous iron formulations are given because of their high effectiveness and low cost. The government can also organize programs related to the importance of iron during pregnancy.

***Xu Xiong, Pierre Buekens, Sophie Alexander, Nestor Demisnczuk, and Elisabeth Wollast et al.,* (2000)** performed Meta-analysis to understand the link between maternal anemia and various outcomes. It was recognized by MEDLINE and was conducted based on public literature. A manual search was done from the year 1966 till 1999. The ratio was measured between the exposure and an outcome, and they were categorized based on the gestational age at anemia diagnosis. From meta-analysis, they identified that there was

some relationship between maternal anemia in pregnant ladies and preterm birth and it was not associated with fetal growth. They also found out that anemia during late pregnancy was associated with low birth weight and preterm birth. Regardless of what stage the pregnant women are, there was no statistical evidence to prove that anemia was associated with the hypertensive disorder. They also could not conclude about the link between perinatal mortality and anemia. Poor resources could be a causal factor for maternal anemia few studies indicated. They conclude in their article that the risk of preterm birth is increased with early pregnancy anemia. Plasma volume expansion could be altered because of anemia during late pregnancy.

Blanca Ribot and Victoria Arija et al., (*2018*) conducted a panel study during the year 2007 to 2012 which included 11,259 pregnant women. They were monitored by primary health care centers in their area. Their objective was to assess the frequency of anemia and the likeliness of haemoconcentrationand its risk factors during the 3 trimesters of pregnant ladies in the area of South Europe. At the health care centers, they collected data which included clinical histories, and also collected hemoglobin data each trimester. They were also asked to provide their personal histories like tobacco use, theage of the mother, her social and economic background, the presence or absence of obesity, the type and stage of pregnancy, and also the number of previous births and pregnancies. In a normal pregnant condition, anemia is described as the hemoglobin level <100g/l during the first and third trimesters and hemoglobin level <105g/l in the second trimester of pregnancy. The likelihood of haemoconcentration was described as hemoglobin level >130g/l in the second and third trimesters. From the result obtained from their longitudinal study, the chances of causing anemia increased in the first trimester of pregnancy from 3.8% to 21.5% in the third trimester. During the third trimester of pregnancy, hemoglobin level was >130g/l approximately 10% of the pregnant women. It was also noted that the prevalence of anemia is increased if the mother is younger than 20 years of age and chances of hemoglobin>130g/l is increased if she is older than 34 years of age. They conclude in their article that being the most common and major public health concern, it is very important to

understand the factors that can help overcome this public issue and to provide guidelines on the importance of iron supplementation during pregnancy.

CHAPTER 3

MATERIALS AND METHODOLOGY

The aim is to develop a malt powder using only three ingredients which have undergone processing methods like roasting, powderingetc. They were made in different ratios and were selected based on their sensory evaluation. These are then checked for their nutrient content, especially iron and folic acid.

3.0 MATERIALS

3.1.1 RAW INGREDIENTS

Ragi floor, jaggery and peanuts

3.1.2 EQUIPMENTS AND GLASSWARES

Analytical balance (Essae Model No FB-6000), Hot air oven (Lab tech Universal Hot Air Oven Model No BD150), Muffle Furnace (Roteck Muffle Furnace), Desiccator, Spectrophotometer (Double beam Spectrophotometer Model No 2375), Centrifuge (Remi model No R-8C), Water bath (Labtech Serological Water bathmodel No 57).

Petri plates (80 × 17), crucibles (infuse), burette (borosilicate glass 3.3), conical flask (boro 3.3), standard flask (borosilicate 3.3), micropipettes(daytech), test tubes (borosilicate3.3), cuvettes (glass square cuvette, light path10 mm), glass tube, spatula.

3.1.3 CHEMICALS USED

Medilise chemicals, Kerala:

Sulphuric acid (CAT No MS1332), Sodium hydroxide pellets (CAT No MS336)

Changshu Hong Sheng Fine Chemicals Colimited, China:

Ethanol (18- 06 – 30)

Indus Labs, Hassan:

Distilled water (CAS No 7732-18-15)

Sisco Research Laboratories Private Limited, New Mumbai:

Potassium permanganate (73-53-9), potassiumpersulphate, potassium thiosulphate solution.

3.2 METHODOLOGY

Collection of the sample

20 grams of solid jaggery, 30 grams of fresh peanuts and 50 grams of ragi floor were collected for the preparation of malt powder.

Powdering of jaggery

20 grams of jaggery were then ground to fine powder using a mechanical grinder.

Roasting of peanuts

20 grams of fresh peanuts were then roasted, until the color changes to golden brown.

Powdering of roasted jaggery

Roasted peanuts were then powdered to fine particles using a mechanical grinder.

Roasting of ragi floor

50 grams of ragi floor was roasted until there is a color change and then it is allowed to cool.

3.2.1Standardisation of the product

Three variations are used to select appropriate malt powder. It was done based on sensory evaluation.

Table 3.2.1 : *Standardisation of the product*

Ingredients	Variation 1 Roasted peanuts Roasted ragi (in g)	Variation 2 Unroasted peanuts Unroasted ragi (in g)	Variation 3 Roasted peanuts Roasted ragi (in g)
Jaggery	20	20	20

Peanut	30	30	20
Ragi flour	50	50	60

3.2.2 Sensory evaluation of malt powder:

Three variations of malt powder were then subjected to preference test with random sampling using the sample size of 50.

3.2.3 Nutritional Estimation

The nutrient content of the product is determined using different methods where the moisture content, fiber content, iron content and folic acid content is determined.

-

3 2.3 a) Determination of Moisture Content by Air oven method

A sterile lass Petri plates were taken, and its weight was noted down, on that 5 gram of the malt powder was taken. The triplicates of sample were dried in the hot air oven at 125°c for four hours. The samples were cooled in the desiccator for 30 minutes and the weight was noted (C1). The samples were placed in the oven for one more hour at 125°c. The samples were cooled for 30 minutes in the desiccator and the weight was taken (C2). The average of both the weights were taken and was substituted in the formula to obtain the percentage of moisture. Moisture percentage was calculated as

(Weight of Petri dish+ sample prior drying in g)- (weight of Petri dish + sample prior drying in g * 100)

$$((Weight\ of\ the\ petrodish + \ sample\ prior\ drying)(g) - \frac{(weight\ of\ petridish + \ sample\ prior\ drying)(g))}{Weight\ of\ the\ food\ sample\ (g)}$$

$$\frac{B-C}{A} * 100$$

3.2.3 b) Determination of Fiber Content

In a 500 ml beaker, 2 grams of food sample was weighed, to which 200 ml of 0.255 N of sulphuric acid solution was added and boiled for 30 mins. It was filtered using a muslin cloth and washed with 200 ml of boiling water, till all the acid was washed off. The filtrate was transferred to the same beaker to which 200 ml of 0.313 N of sodium hydroxide solution was added and boiled for 30 mins. The contents were filtered in a filter paper washed with water and were dried for 2 minutes in hot air oven for 250°c and the dried sample was scraped off to the weighed crucible and was dried again for 100°c for 4 hours. It was cooled and weighed, the contents were placed in the preheated muffle furnace at 600°c for 30 mins, cooled and weighed. The crude fiber content was calculated by substituting in the formula.

Crude fiber percentage is calculated as follows;

$$\frac{Weight\ of\ the\ crucible\ before\ ashing - Weight\ of\ the\ crucible\ after\ ashing}{Weight\ of\ the\ food\ sample}$$

3.2.3 c) Determination of Iron Content by Wong's method

To detect the iron content in the food sample, 1 ml of the ash solution was used as the test sample. The standard iron solution was prepared using Mohr's salt of 100 mg/ml concentration and 1 to 5 ml was used which was made up to 5 ml using distilled water. The blank was prepared using 5 ml of distilled water and 1 ml of ash solution was made up to 5 ml with distilled water. To all the test tubes 1 ml of 30 % sulphuric acid and 1 ml of 7% potassium per sulphate solution and 1 ml of 40 % potassiumthiocyanate solution was added. The test tubes were kept at room temperature for 10 mins and the absorbance was read at 490 nm.

CHAPTER 4

RESULTS AND DISCUSSION

The methodology used for analysis of malt powder is tested and the outcome of the experiment is depicted in the section of results. The data obtained by the section of results and discussion gave a clear picture on the authenticity of the product along with the accuracy of the experiments undertaken.

4.1 SENSORY EVALUATION:

After doing sensory evaluation of three variations final product was chosen. It was assessed by 50

People, and were marked based on their preference. Out if three variations third variation (jaggery = 20g, peanut =30g and ragi = 50g) was liked most by the consumers and hence it was selected as the final product.

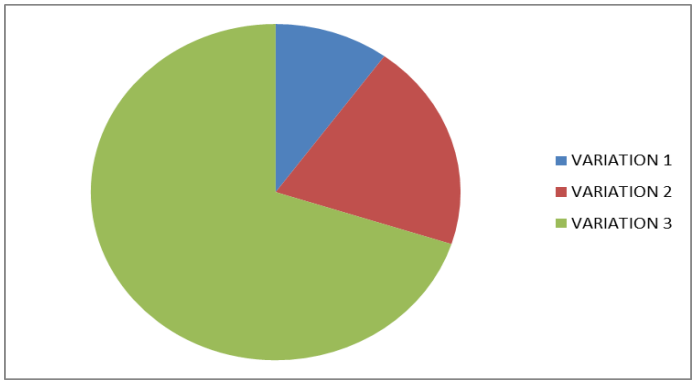

Figure 4.1 : sensory evaluation of malt powder

Variation 1, 5/15*100 = 10%

Variation 2, 10/15*100=20%

Variation 3,35/15*100=70%

From the above data third variation was selected as the final product.

4.2 MOISTURE CONTENT ESTIMATION:

Product	**Moisture in grams**
Malt Powder	1.28 grams

4.3 FIBRE CONTENT ESTIMATION:

Product	**Fibre content in gram**
Malt powder	2.73 grams

***Table 4.3** : fibre content of malt powder.*

4 4 IRON ESTIMATION OF MALT POWDER USING WONG'S METHOD:

Product	**Iron content in mcg**
Malt Powder	32 mcg

***Table 4.4**: iron content of malt powder.*

4.5 FOLIC ACID ESTIMATION :

Product	**Folic acid content in mcg**
Malt powder	81.15 mcg

***Table 4.5** : folic acid content of malt powder.*

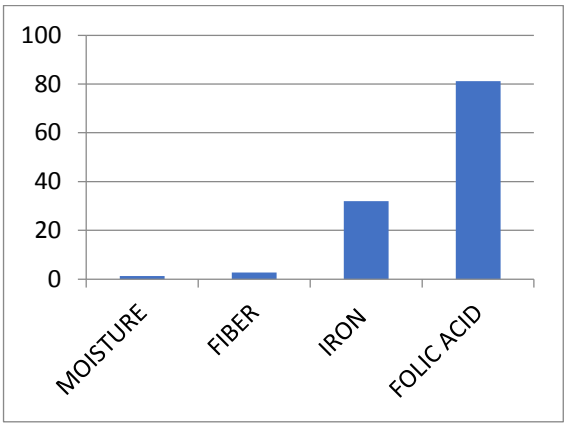

Figure : *nutrient estimation of malt powder*

4.6 SHELF-LIFE STUDY:

The sensory characteristics of the malt powder were observed in different sessions.

First day – Sensory characteristics of malt powder, ie. Colour, flavour taste appearance, and odour were analysed.

First month - No much changes in sensory characteristics were seen.

Second month – Sensory characteristics remained the same. It was still acceptable.

Third month – Sensory characteristics remained the same. No changes were seen. It was still acceptable.

From the above shelf life study, we can conclude that the shelf life of malt powder is 3 months and above

Chapter 5

SUMMARY AND CONCLUSION

According to above results and discussions, we can get a clear picture of the product, that it is high in iron and folic acid. The child life of the product was upto 3 months and can be given to pregnant ladies with milk either during daytime or night. Hence it is very useful for pregnant ladies to overcome micronutrient deficiencies

5.1 SUMMARY

* Sensory evaluation test helped select appropriate variation of the product as it was evaluated based on hedonic scale by 50 people.
* Processing methods like roasting and powdering is simple and cost effective, as well as improve tastes and nutritional properties.
* Selection of appropriate processing techniques for ragi, jaggery and peanuts would favour the acceptability and palatability of the final product. Variant of a processing method best suitable for the ragi, jaggery or peanut would improve its role in final product.
* On evaluating the consumer preference about chose the malt powder of ragi 50 g, jaggery 30g and peanut 20g.
* The nutrient composition of malt powder was found to be 32 mcg of iron, 81.15 mcg of folic acid, 1.28 g of moisture and 2.73 g of fibre.
* The malt powder was then seen for their shelf-life study, and it remained till 3 months without getting spoilt.

5.2 CONCLUSION:

Iron and folic acid is very essential for all age groups, especially children and women. During pregnancy there is huge loss of RBCs

And thus, there is a chance of getting anaemia, genetic defects like neural birth defect because of deficiency of folic acid. Thus, malt powder was prepared which is rich in both iron and folic acid. Jaggery and ragi contain iron, and peanut contains folic acid. They have also undergone simple processing methods like roasting, grinding to improve their nutrient content and also its flavour.

Since it is malt powder, pregnant ladies can drink it either hot or cold with milk. By drinking this during pregnancy they can overcome iron deficiency anaemia and neural birth defect during pregnancy.

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APPENDIX

APPENDIX Ⅰ

PREPARATION OF REAGENTS

1. ESTIMATION OF IRON BY WONG'S METHOD

□ 30% sulphuric acid solution

30ml of concentrated sulphuric acid was taken in a 100ml standard flask which was made up to mark with double distilled water.

□ 7% potassium per sulphate solution

7gms of potassium per sulphate crystals were weighed in the analytical balance and were transferred to 100ml standard flask using funnel which was made up to mark with double distilled water.

□ 40% potassium thiocyanate solution

40gms of potassium thiocyanate was weighed in the analytical balance and were transferred to 100ml standard flask using funnel which was made up to mark with double distilled water.

□ Concentrated potassium permanganate solution

10gms of potassium permanganate was weighed in the analytical balance and transferred through a funnel to the 100ml standard flask and was made up to mark with double distilled water.

□ Standard iron solution

0.702gms of crystalline ferrous ammonium sulphate (Mohr's salt) was weighed in the analytical balance and dissolved in 100 ml of double distilled water and 50ml of concentrated sulphuric acid and was warmed slightly.2-3 drops of concentrated potassium permanganate solution was added until the solution turned permanent pink colour. The solution was transferred to 1000ml standard flask and made up to with double distilled water. The concentration of the solution was 1mg/ml. 10 ml of stock solution was taken in a 100ml standard flask which was made up to the mark with double distilled water. The concentration of standard iron solution was 100µg/ml.

2. FIBRE ESTIMATION BY AOAC METHOD.

 0.255N sulphuric acid solution

7ml of concentrated sulphuric acid was measured in a volumetric cylinder and was transferred into 1000ml standard flask using funnel, made up to mark with distilled water.

 0**.313N sodium hydroxide solution**

12.38 Gms of sodium hydroxide pellets were weighed using analytical balance and transferred to a 1000ml standard flask and was added with distilled water until the pellets dissolved. It was made up to mark with distilled water.

APPENDIX 2

QUESTIONNAIRES AND FORMS USED FOR PRODUCT ANALYSIS

FORM 1:

Paired preference test to choose the best malt powder

Name:_____

Date: _____

Note: Rinse your mouth before starting the test. Taste at least half of both the samples A,B and C given, you may drink water after tasting each sample. Re -tasting is not allowed.

Put tick mark on the best sample you liked out of the three on the basis of overall acceptability.

A. ☐ B. ☐ C ☐

Answer these questions considering the malt powder you preferred;

1. Did you like the product?

Yes ☐ No ☐

2.What quality did you like the most?

☐ Taste. Appearance ☐ Texture. ☐

Aroma. ☐ ☐ Flavour

3. Could you make out that the malt powder was made out from peanuts jaggery and ragi floor ?

☐ ☐

Yes. No

If yes, based on what did you recognise_____

4.Do you think that this malt powder would be liked by all age group?

Yes ☐ No ☐

5.Would you like to alter the sweetness of the malt powder?

Increase Sweetness ☐ Decrease Sweetness ☐

☐

Keep It As It Is

6.Would you like it, if, this Iron rich malt powder is incorporated in your daily diet?

Yes. ☐ No ☐

7. On the whole what did you feel about the product?

Very Good. ☐ Good. ☐ Average ☐

Bad ☐ Very bad ☐

FORM 2:

Shelf life Study Of Malt Powder Using 9 Point Hedonic Scale Rating

Taste the sample given and rate it from 9 to 1 based on your preference for the particular characteristics mentioned below;

9-Like Extremely
8-Like Very Much
7-Like Moderately
6-Like Slightly,
5-Neither Like nor Dislike
4-Dislike Slightly
3-Dislike Moderately
2-Dislike Very Much
1-Dislike Extremely

Sensory characteristics	**1st Month**	**2nd Month**	**3rd Month**
Appearance			
Colour			
Texture			
Taste			
Aroma			
Overall acceptability			