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Research Article

DEVELOPMENT AND PHYSICOCHEMICAL ANALYSIS OF GLUTEN FREE PASTA USING RICE, CORN AND FLAXSEEDS

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ABSTRACT

People suffering from gluten sensitivity are allergic to gluten, which is a group of proteins, present in wheat, barley, rye and oats. So there is high demand for gluten free product in the market. Pasta is one of the widely consumed Italian ready to eat food product which has got popularity in past years. The aim of this work was to make high quality fibre rich non-gluten pasta using rice (80-45%), corn (45-80%), flax seeds(10%), water(25-30ml) and egg(1-2) utilizing expulsion procedure. The difficulty was to give binding property to the prepared product without the presence of gluten. To do that, trials with various formulations of rice, corn and flax seeds were made so as to get desired product. The pasta was extruded and was dried at 25°C for 24 hours to get a moisture content of 9%. On dried samples different tests were performed to discover best formulation, to find out which formulation was close to our desired product. The outcomes were found and compared based on physicochemical analysis (such as: moisture content, cooking loss, fat content and protein content). It was found that the best pasta composition was 10% flax seeds, 45%rice flour and 45%corn flour with 25ml water and 1 egg. This ideal formulation was produced and put to sensory evaluation. This composition also had a few parameters to be improved like texture which was close enough to our desired product. Indeed 80%of the specialists did not deny eating this pasta once more, and with tomato sauce no distinctions were seen between the market accessible gluten free pasta and our plan.

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INTRODUCTION

Pasta is a primary dinner of Italian cooking. Pasta is ordinarily produced using fowl flour of refined wheat flour mixed with water or eggs, and is made in sheets or different shapes, at that point cooked or heated. Rice flour, or vegetables, for example, lentils or beans are once in a while utilized as a different flavor and surface, or a without gluten substitute (rather than wheat flour) (Padalino *et al.*, 2016). Pasta is available in two forms: dried (pasta picka) and fresh (pasta fresca). Most of the dry pasta is produced commercially using an extrusion process, even if it can be produced at home. Fresh pasta is traditionally hand-made, sometimes with the help of simple machines. (Hazan, 1993) Fresh pasta available in grocery stores is commercially produced by large scale machines.

Dried and fresh pasta come in a number of both shapes and varieties, in which there are 310 definite forms which are

known by more than 1300 documentary names. (Field *et al.*, 2009). In Italy, names of explicit pasta shapes or types are regularly extraordinary by local people. For instance, Pasta Form Cavetelli is known by 28 distinct names based on city and area. Regular types of pasta incorporate long and short shapes, tubes, level shapes or sheets, smaller than expected shapes for soup, which are filled or filled and exceptional or enriching shapes (Hazan, 1993).

Gluten is a group of protein comprising of two major protein that is prolamin and glutelin which is stored in endosperm of various cereals in the form of starch. Gluten is present in wheat, barley, rye and possibly oats products which are the highly consumed staple foods. Gluten affects the villi of small intestine by reducing their surface area and lack in absorption and increases gastric disorders (Broz and Horne, 2007), which results in malabsorption (deficiency of vitamins and minerals, weight loss etc). chronic diarrhoea, vomiting, abdominal

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distension, etc. are the common symptoms of celiac disease (CD). Celiac ailment (CD) is an immune system issue with a foundational and interminable red hot safe response against gluten and gluten-related prolamins from wheat (gliadin), grain (hordeins), rye (secalins), and certain oat collections (avenins) in genetically slanted individuals. Conservative plate addresses the most generally perceived sustenance extremism in western culture, with a normal inescapability of around 1 % of the masses (Dubé *et al.*, 2005).

Gluten use by CD patients triggers a clinical symptomatology which conventionally appears as detachment of the insides, stomach distension, and hurls finally inciting enhancement malabsorption, exhaustion, and absence of solid sustenance (Sollid, 2002). 0.3 to 1% of the total populace (Rubio-Tapia and Murray, 2010). is influenced by CD which is an auto-insusceptible confusion entaropathy portrayed by changeless narrow mindedness to gluten (Fasano *et al.*, 2008) .A supposition that is made that it is available up to 1 of every 100 of the populace (Walker and Talley, 2011), but the medically diagnosed population of the patients are 10-15% only, the female to male ratio of gluten affected people is (2:1) that means females are more affected by gluten intolerance than males. (Polanco, 2008). The increase in population of CD affected people has also increased the demand for gluten free products in the market. People now-a-days are likely to follow a healthy and gluten free diet (GFD). The standard therapy of CD was introduced 50 years ago as (GFD) (Fasano *et al.*, 2008). Gluten sensitivity is of three types- wheat allergy, celiac disease and non- celiac disease .

Seeing the growing demand of gluten free products not only by the population suffering from CD but also by healthy people or by their relatives who believe that a GFD healthier and a good lifestyle to be adapted (Packaged facts report , 2011). Cereals other than wheat, barley , rye and oats (not is case of every patient but in many can cause symptoms of CD) and other hybrid variants or derived products, are used to make gluten free products like biscuits and cookies, pasta and noodles , cake and muffins, beer and beverages and many more are getting high on demands.

MATERIAL AND METHODOLOGY

Raw Material

The raw materials rice, corn and flax seeds were bought from the local market of Premnagar, Dehradun, Uttarakhand. Rice grain and maize grits were bought and grinded to the particles of flour size with the help of grinder to obtain particle size of 120mm.

Preparation and Formulations of Pasta

The flours were mixed in different proportions to develop a desired pasta sample. The rice and maize flour were taken in 8 different proportion whereas flaxseeds and egg were kept constant throughout the formulation. The formulations of total 100g was made with these different compositions:

Table 1 Formulations of pasta samples

Samples	Rice flour	Maize flour	Flaxseeds powder	Number of eggs
Sample 1	10g	80g	10g	1
Sample 2	20g	70g	10g	1

Sample 3	30g	60g	10g	1
Sample 4	40g	50g	10g	1
Sample 5	45g	45g	10g	1
Sample 6	50g	40g	10g	1
Sample 7	60g	30g	10g	1
Sample 8	70g	20g	10g	1
Sample 9	80g	10g	10g	1

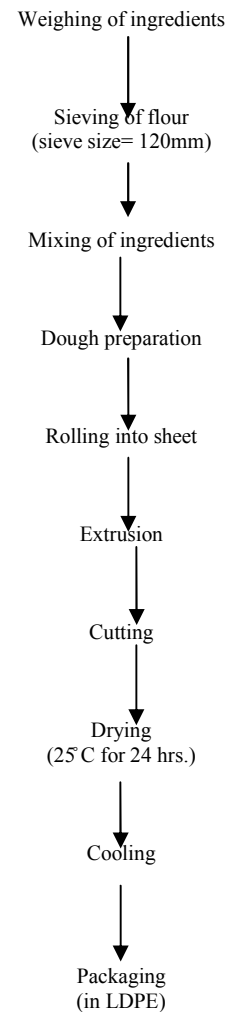


Fig 2.1 Flow chart for pasta preparation:

The ingredients were weighed, sieved and were mixed with water and egg to form a dough. The dough was kept on rest for 15 minutes for the egg , water and other ingredients to for a binding network as our product is gluten free and lack binding property therefore egg is added as a binding agent and obviously to enhance the nutritional property of our pasta sample. The dough was then sheeted in thin sheet to 7mm with the help of rolling machine. Once the sheeting is done, the sheet is put into extruder for cutting or shaping. The extruder was manual so there was no constant speed or force applied on the pasta. The spagity pasta that was extruded was placed on the tray and then dried at a temperature of 25° C for 24 hours or at a high temperature in tray drier at 131° C for 2 hrs. after cooling the pasta was packed into LDPE packets.

Physicochemical Analysis of Pasta

Moisture Content

AACC method 44-19 (AACC, 2000) was used to determine the moisture content of the samples . 2g dried pasta was placed in hot air oven at 131 degree Celsius for 2hours. The large

scale differentiation between the initial and the final load gives the humidity (moisture) of samples:

$$\text{Moisture content} = \frac{W_1 - W_2}{W_1} \times 100$$

W₁ = weight of dried pasta (g);

W₂ = weight of original (wet) pasta (g)

Ash Content

Total ash content was determined by AOAC, 1984 method. 5g of sample was taken in a dried and pre weighed (W₁) silica crucible and the weight is recorded as W₂. The crucible was then ignited over heater until fumes ceased off. Ashing was done in a muffle furnace at 450±5° C until sample was become carbon free. The sample was then removed and weighed and its weight recorded as W₃. Difference in weight of sample before and after ashing, expressed as % total ash follows:

$$\% \text{ Total ash} = \frac{W_2 - W_1}{W_3 - W_1} \times 100$$

Where,

W₁= Weight of empty crucible in (g)

W₂= Weight of crucible + sample before ashing in (g)

W₃= Weight of crucible + sample after ashing in (g)

Optimal Cooking Time

The ideal cooking time (OCT) was resolved by AACC endorsed strategy 66-50, where tests of 5 grams of dried pasta were bubbled in 200 ml refined water. Like clockwork, pasta was expelled from bubbling water and pressed between two bits of Plexiglas. Pasta was viewed as cooked when the inside center vanished

Water Absorption

Water assimilation (WA) was resolved by AACC endorsed strategy 66-50. Amid the recommended cooking time, 10 grams of dry pasta tests were bubbled in 300mL of water. At that point, pasta was evacuated and weighed when bubbled totally (check with plexiglas). The distinction in weight when cooking was utilized to compute water retention.

$$\text{WA} (\%) = \frac{W_1 - W_2}{W_2} \times 100$$

W₁= weight of cooked (wet) pasta in (g)

W₂ = weight of dried pasta in (g)

Cooking lose

Solids particles that spread from cooking pasta to water, is known as cooking misfortune (CL). CL was estimated by adding cooked pasta to a stove at 50 degree Celsius for 48 degrees (utilizing indistinguishable units from recently referenced). The cooked pasta is dried in stove and the distinction between the heaviness of unique example taken to the heaviness of broiler dried pasta gives us the cooking misfortune

$$\text{CL} (\%) = \frac{W_1 - W_2}{W_1} \times 100$$

W₁= weight of dried pasta in (g)

W₂= weight original pasta in (g)

RESULT AND DISCUSSION

Physicochemical Analysis of Pasta

Moisture Content

The moisture content of sample 3 and sample 7 was noted equal but little more than other samples as shown in fig. 4.1.1 . The two factors on which moisture content is dependent are the MC of dough and drying process. From the studies it is concluded that the moisture content does not depend on the amount of water used to make dough. According to **Bustroset al., (2015)**, the moisture content of pasta should be equal to 12.5% or less in order to avoid contamination after drying. The calculated moisture content of our samples was less than 12%

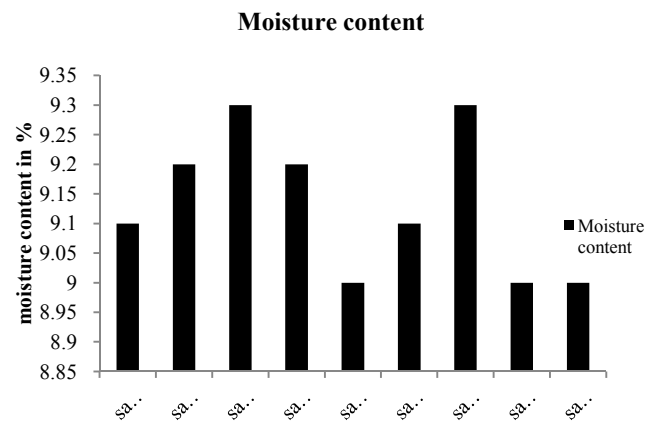


Fig. 4.1.1 Moisture content

Ash Content

The ash content is the total mineral content present in the the sample. Different proportion of minerals are present in our samples sample 9 has the highest mineral content where as sample 3,5 and 8 has the least mineral content as shown in fig.4.1.2.

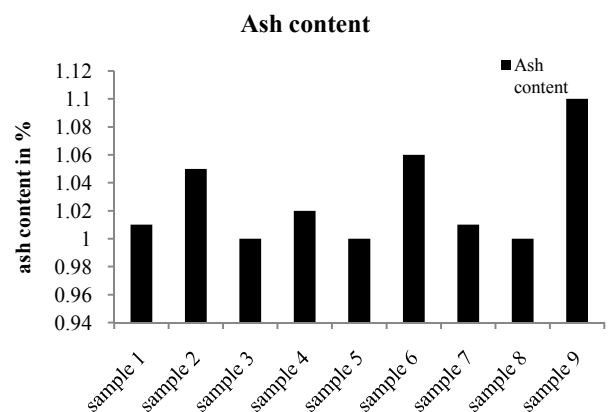


Fig 4.1.2 Ash content

Water Absorption

The water absorbed by the sample amplified with the raise in the concentration of rice. It was noted that most of the water in the sample 9 was absorbed, while sample 1 absorbed the minimum amount of water, as shown in Figure 4.1.3. As by Rosa et al., (2015), the large scale boost of pasta depends on

size, quality and timing of cooking. During the drying of polymerization, the decomposition and up gradation of the proteins was authorized to make a solid film on the pasta surface. But during boiling, the film gets spoiled by cooking water which enters the protein matrix. To one side from this, on the other pass, starch granules soak up water and become hilarious. As a result, the amount of pasta increased.

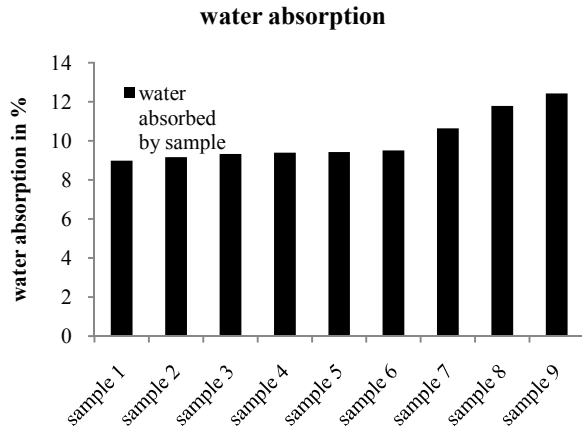


Fig 4.1.3 Water absorption

Optimal Cooking time

With an expansion in the convergence of rice, the ideal cooking time (OCT) expanded as the starch granules set aside effort to assimilate water and cook. In this way, Sample 9 had the most extreme cooking time where there was minimal portrayal as Sample 1 in Fig. 4.1.4. The technique used to decide the cooking time for pasta tests is very questionable, so OCT was resolved utilizing triple to refine the interim of the best cooking time. The cooking time for all examples was over 14 minutes. Gluten arrange has been imitated more in pasta with high rice fixations. Thus, a defensive layer was shaped on the outside of pasta. In this way, additional time is required by water to achieve pasta framework, principally pasta focus. Notwithstanding the egg diminishes the section of water in the mixture and therefore improves cooking time.

Indeed, the protein arrange was less strong on account of without gluten pasta and it influences the passage of water amid cooking (protein film is bothered amid the section of water). Information recommends that the protein arrange was pretty much satisfactory relying upon the measure of various grains. As a matter of fact, the higher the amount of rice, the more noteworthy the ingestion of water. This was in opposition to corn and flax seeds.

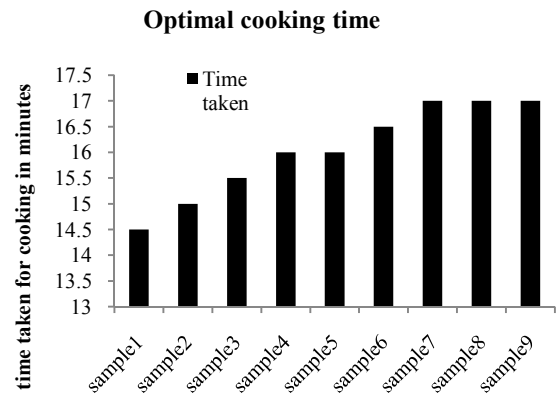


Fig 4.1.4 Optimal cooking time

Cooking Loss

The amount of solid going in the water amid cooking is additionally a significant angle for quality pasta items. The principle structures of pasta are starch and proteins, and the central matter of cooking misfortune is regularly because of unnecessary starch swelling. Great quality pastas are produced using a protein framework equipped for withstand the aggravation of starch amid cooking. Delcour et al. (2012) demonstrated that an ideal cross-connected protein arrange goes about as a steady structure, starch is trapped, so starch swelling is limited and the loss of cooking is decreased. To realize that the more built up the protein organize, the lower the CL.

The loss of cooking in wheat pasta is normally under 8%, yet the absence of gluten in without gluten pasta can cause an expansion in CL and a diminishing in solidness on the grounds that the starch polymers are less corresponded to the neighbouring substance (Marti et al., 2014). Aside from this, Tudoricaet al., (2002) demonstrated that the expansion in cooking misfortunes could be because of the filaments who utilize over the top measure of water. Along these lines, less water will be accessible for aggravation of starch. The CL estimations of our examples seem, by all accounts, to be adequate as indicated by writing. Most of our example is dependent upon 14 to 20%.

Indeed, the measure of starch based on the kind of grain is unique and it is principally in charge of the loss of cooking. For the most part, FAO (1993) states that rice has 90% starch, in this manner, there ought to be all the more cooking misfortunes when rice is accessible. To influence the cooking misfortune, water estimation likewise appears to be less significant. As found in test 9, the loss of cooking is the most in light of the fact that it contains the most noteworthy measure of rice.

Unit Density

The unit thickness or dimension (UD) measurement is utilized to comprehend the ensnared air in the pasta. On the off chance that there is an excessive amount of air, at that point pasta will have less weight and high volume, which implies less unit thickness. The unit thickness of the examples was not exactly the business pasta, however they were more than 1000 kg/m³, which implies the test pasta won't glide in the water. In this way, it appears that the molecule arrange was great. In spite of the fact that the UD esteem can be emotional based on material,

this relies upon the ground procedure and at the top, mixture massaging time moreover. As a matter of fact, air can be entered amid this progression. As indicated by the past figures, it appears that UD esteems were practically indistinguishable and were reasonable for all examples. Along these lines, this setting was adequate and it was not changed.

CONCLUSION

The goal of this examination was to detail incredible quality short gluten pasta made up of rice, maize and flax seeds. Upgrading the best arrangement, quality thing with commendable parameters was gotten with the going with definition: 45% of rice, 45% of corn, 10% of flax seeds. Certainly, a ton of rice achieves white that attract purchasers. It was imperative to mix the rice with various grains in order to diminish cooking mishap. Corn and flax seeds have both captivating fortifying properties yet corn had a more grounded taste and can get a foul taste degree so the entirety was unimportant. The development of flax seeds was major since it grants making of better surface. With this arrangement, the physicochemical parameters were commendable and were closer to needed thing. In any case, a couple of parameters still ought to be improved, especially the surface. Above all, in order to upgrade this setting, we ought to use flour with a superior smashing. Likewise, changing drying system could improve pastas surface. As opposed to drying pastas for 24 hrs. at including temperature, it could be more brilliant to use a drying methodology with a higher temperature alongside a brief length. Beyond question, inspectors have exhibited that a drying method in a stove can improve pastas surface: 42°C for something like 9 hrs. 14 h at 40°C We may in like manner consider including one or a couple of sorts of emulsifier to the blend (like guar gum or monoglycerides). Without a doubt, joined with eggs, it appears in consider that the extension of an emulsifier grants to procure pasta with better surface (firmer) and more prominent dauntlessness in the midst of cooking (less setbacks). In like manner, the ejection strategy using extruder potentially will improve protein arrangement and thusly surface of pasta since the imperativeness presented to the player would be more conspicuous than that associated in the midst of the removal system by methods for the Kitchen Aid.

As such, as demonstrated by this examination, we can say that without gluten pastas piece was hard to find. Without a doubt, each sans gluten grain has different properties which may affect the quality. To find best without gluten pastas plan, it was basic to mix different oats in order to endeavour to just keep their central focuses and to limit dreadful outcomes. The water sum incorporated the equation was huge and it must not be picked heedlessly. Similarly, the recipe must contain egg whites since they offer a better surface than the thing. Incidentally, it was very difficult to get a firm and sensitive thing, in actuality, in ordinary pastas this surface was make by the gluten which gives a respectable protein sort out. Without its use, we had the ability to have a better than average flexibility yet not a respectable toughness in the thing. The parameter, for instance, surface, solidness must be improved.

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