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ROLE OF CONSUMPTION OF COMPOSITE FLOUR IN MANAGEMENT OF LIFESTYLE DISORDERS

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ABSTRACT

Composite flour is a combination of only either various grains or both various grains and vegetables it is a storehouse of various nutrients like vitamins, minerals, antioxidants, and dietary fiber. In the present day, there has been an increased demand for nutritional and health-based variants of food due to changes in lifestyle and socio-economic status. There is no surprise in saying that people are seeing the food being consumed on a day-to-day basis as a status symbol and are striving to get better quality of health through the food they consume and are ready to spend huge amounts of money on the products which are so-called healthy and are being commercially marketed in a smart manner capturing both peoples mind and attention knowing to bring down various lifestyle disorders like Diabetes, Cardiovascular diseases, Hypertension, Cancer, Atherosclerosis, Ischemic stroke, Obesity, Coeliac disease, Alzheimer's and many other diseases and disorders when consumed frequently in long run. The foods which fall under such category especially are composite flours and ready-to-cook mixes occupying more than 70% of both the food and health industry today being recommended by most of the nutritional experts. This paper is a review-based article collected from various papers focusing on role of consumption of composite flours in management of lifestyle disorders such as diabetes, hypertension, cancer etc.
***Keywords*:** Composite flour, Nutritional importance, industrial status, Health benefits, functional aspects

INTRODUCTION

Eating healthy for sustaining a healthy life is the wish of every human being but with the changing lifestyle & stress from the daily schedule of life this dream of healthy living going too far. The utilization of composite flour in daily diets has some health effects on our lifestyle. Composite flours are known as mixed flours as they include starches & other ingredients that replace wheat partially & totally and are used for the production of bakery and pastry products. They are either binary or a ternary mixture of flours from crops like soybean, gram, cassava, mung bean, etc. with or without wheat flour (Dendy, 1992). Composite flours are under the spotlight today for being well known to bring down various lifestyle disorders when consumed frequently in a long run and hence are capturing a major part of the commercial food and nutritional industry today due to the people becoming more aware and concerned towards their health as they kept running out of time due to their busy lifestyle and schedule. The increasing demand for healthy food and growing market for confectionaries pave the way towards the substitution of wheat flour for the production of products. Nowadays, several companies come at the market level to evaluate the viability of alternative flours available to combat wheat flour for nutritional aspects (Chandra *et al.*, 2015). The FAO stated that the use of composite flour for fabrication of various food products would be efficiently advantageous if the significance of wheat flour could be decreased or even removed and demand for production of bread & pastry products could be met by the routine of domestically grown products as a replacement of wheat. The manufacture of bakery products using composite flour was of virtuous features with some features similar to wheat flour bread, however, the texture & some properties of composite flour are different with enhanced nutritional and appearance value (Chandra *et al.*, 2015; Abdelghafor *et al.*, 2011). No doubt, wheat is a good source of calories but it is considered poor cereal as its deficient in essential amino acids namely lysine and threonine. Thus, the addition of wheat flour with other inexpensive staples like cereals & pulses benefits the nutritional status of wheat products. New composite flour mixes are being introduced by emerging food industries and also by health professionals and nutritionists to combat the deep-rooted food insecurity, malnutrition, and certain diseases in children and adults. These composite flour mix prepared by combining cereals and legumes are economical which contain locally available ingredients to improve the overall food and nutritional quality (Fenn *et al.,* 2010). The composite flour mix was developed using sorghum flour, whole wheat flour, khesari dal flour, sweet potato flour, and flaxseed flour at a different level of incorporation. Hence the present study was undertaken in an attempt to develop a composite flour mix from functional ingredients. In the 21st century, the new lifestyle adopted by people has changed their basic food leading to the consumption of more processed foods which leads to several lifestyle disorders and the onset of metabolic diseases due to improper nutrition (Menon *et al.,* 2015; Noor Aziah *et al*., 2009).

In 1964, FAO initiated the concept of composite flour technology targeting the use of indigenous crops such as millets, legumes, and other root crops in substitution of wheat flour to improve the food availability and food security of the population. The composite flour concept is a growing concept that is gaining wider recognition and acceptance amongst nutrition scientists, being a simple sensible scientific approach in harnessing nutrient sources to meet human needs. It has been used to develop food products for clinical and non-clinical population groups (Zotor *et al.,* 2015). As it has been reviewed from the literature available at scholastics sites that composite flour isa health-promoting and beneficial component available to replace wheat flour. Thus, the present review provides a spotlight on composite-based flours available at the market, their nutritional importance, food industries aspects, and also the health benefits.

Various types of composite flours

There are numerous formulations of composite flours available commercially today due to the increased demand for more fiber content in the food being consumed on which the various research works have been carried out and several articles have been published in different journals. Listed below are some such formulations collected from different reviews and research-based articles. A study was undertaken to evaluate the functional and sensorial attributes of biscuits made out of composite flours by (Chandra *et al*., 2015) by blending different ingredients like wheat flour along with rice flour and green gram flour along with potato flour and curry leaves powder in different ratios and were baked using the conventional method at 180 degrees Celsius for around 10-15 minutes and various functional properties of them were tested by using different methods and materials. Another undertaken by a team of Agrahar Murugkar *et al*. (2014) to evaluate the various attributes like textural, nutrient quality, of biscuits developed using composite flour made by blending both sprouted and malted ingredients which comprised using flours obtained from corn, whole wheat, sorghum, finger millet (whole), both green gram dal whole and split, peanuts (unsalted), papaya, dairy whitener and isolate of soy protein all the ingredients were taken in different quantities and powdered using various methods the flours were sieved through the mesh of 300 microns and combined it was found that biscuits made out of multi-nutrient composite flour were superior in all the physical and functional aspects and were found to be healthy. A study reported by Noorafarahzilah *et al.* (2014) to see the applications of composite flour in the development of various food products like bread, pasta, biscuits, etc. The development of food products using composite flour has increased and is attracting much attention from researchers, especially in the production of bakery products and pastries. This article focuses on the use of composite flour to produce food products, namely bread, biscuits, and pasta, with looks at on its impact, following some improvements made, on the sensory quality, rheology characteristics, and nutritional values as well as its overall acceptance. The blending of wheat flour with various sources of tubers, legumes, cereals, and fruit flour in different percentages to produce a variety of food products is also reported in this review. It was found that composite flour used to produce food products is still able to maintain similar characteristics to products made from full-wheat flour. The positive effects of the use of composite flour can be seen in the final product related to the functional and physicochemical properties and health benefits of raw blended flour along with percentage blending. Overall, composite flour is a good new approach to utilizing uncommon food products as the application of composite flour produced products with different characteristics and quality, depending on the types and percentage of wheat flour used in the formulation. The various types of flours for product development are discussed in Table 1.

Role of Composite Flours in Food Industry

Composite flour is the combination of different protein-enriched foods and starches. The most used starches and protein to prepare the composite flour are jam, sweet potatoes as well as also peanut and soy, respectively. Different cereal and pulses are used to make composite flour including rice, millet, barley, maize, wheat, chickpea, and corn. In recent years, consumers have diverted their attention towards ready-to-eat snacks due to lack of time and changes in lifestyle and eating habits (Ju *et al.,* 2006). The production of composite flours gives a chance to the producers to attain and support their crops. Changes in the pattern of lifestyles and shifting of a large population to urban areas lead to enhance the consumption of flour to prepare bread and other bakery commodities. In developing economies, blended flours are good in nutrition and make them more economic due to the presence of cheap ingredients (Ayo *et al.,* 2014). This phenomenon caused a reduction in prices and is readily available. Composite flours play a significant role by replacing wheat flour and are more economical by decreasing the wheat imports. This flour has a role in confectionery products whereas deficient in essential amino acid in wheat and enrichment of threonine and lysine in pulse flours. Mixing of these flours makes flour more nutritionally and economically (Chandra *et al.,* 2015). The composite food's functional characters are markedly enhanced with the increment of flours through the addition of emulsion stability, swelling capacity, and bulk density, accordingly.

Composite flour is mainly used to enhance the nutritional values, and quality of the product in bakery products, besides, it also prevents the suffering from degenerative diseases associated with the modern lifestyle (Mughal *et al.,* 2019). The main aspect of the utilization of composite flour is for the production of bakery and pastry flours to fulfil the nutritional demand of humans, to better supply of protein, to reduced cost in developing countries by stopping the importation of wheat flour and selecting alternative for wheat flour. As wheat is deficient in essential amino acids and considered nutritionally poor, therefore utilization of composite flours for the fabrication of bakery & pastry products is a blessing for food industries and humans as they improve the nutritional value & protein content of products. By taking into account example; soybean, cassava, and sorghum flours are highly rich in protein content as compare to common wheat flour (Iwe *et al*., 2016; Abioye *et al.,* 2011). The bakery goods differed in nutritional composition by incorporation of different value-added ingredients. The growth of composite flours in bakery and pastry goods enhances a growing number of studies on the different materials used for the manufacture of flours and their effect on physio-chemical & functional aspects of food products. Composite flour products are a course with a bundle of nutritional importance (Sawant *et al*., 2012). The multigrain is used mostly in bakery and breakfast cereals production and they provide a positive effect on the taste & texture of the product and enhance the acceptability and health benefits of products. They also have a role to reduce diabetes, cardiac attack, help to control weight, improve the digestive system, etc. There was a need to enumerate the various grains for the production of baked goods (Ho and Aziah, 2013).

Nutritional composition of various composite flours

The composite flours are prepared by the addition of different ingredients like soy flour, chickpea flour, soybean flour, and addition of other substitutes available regarding wheat. The composite flour has high protein, ash, amino acids, and compounds such as Zn, Cu, K, Mg, Ca. Wheat is the main and very widely used flour for the manufacture of bakery products as it has the congenital property to form dough & retain gases (Krishnan *et al*., 2011). The wheat has protein content as low as 8 to 15 %. Wheat flour is used for the production of bakery products including cookies, noodles, bread, cake, and pastries. Incorporation of different flours with wheat for the production of composite flour for bakery goods production is probable to create an effect in the functional properties of the combined samples (Bhatt and Gupta, 2015). Legumes like soybean, chickpea, lentil are a good source of proteins, vitamins, carbohydrates & minerals and are utilized for traditional diet consumption. Soybean legume is an excellent healthy bean as it contains a high amount of protein and its oilseeds have oil 18 %. Soy protein is good in lowering cholesterol levels and has excellent properties and its amino acid profile is good among other plant proteins (Islam *et al*., 2012). It is also rich in soluble fibers, calcium, phosphorous, and vitamins. Oats flour is mostly used for the manufacture of bread, muffins, cookies, rusk, pastry, biscuits, etc. oats are rich in dietary fibers and soluble dietary fibers ß-glucans. They are excellent in lowering the blood glucose and cholesterol level of the body.

Oats are a good substitute for diabetic patients. Millets used for the production of flours are rich in vitamin B, minerals including iron, calcium, phosphorous, dietary fibers, polyphenols, and lipids. Millets do not possess gluten so they could be supplied to ones with celiac disease (Krishnan *et al*., 2011). Millets also have good nutritional and sensory properties and their hypoglycemic properties are underlying so, they can be explored better for future product production. Rice flour is also utilized for the production of bakery products but due to the presence of prolamins (2.5-3.5 %) in rice its viscoelastic feature doesn't advance in the production of flour when kneaded with water (Chandra *et al*., 2015). The literature has reported that the addition of 4% hydroxypropyl methylcellulose (HPMC) in rice flour made it real to explore bread from rice flour. Maize flour also supplied a high level of vitamins and minerals including zinc, phosphorus, iron, calcium, potassium, niacin, thiamine, folate, vitamin B6, etc. The fortification of maize flour up to 40 % & defatted maize germ flour at 15 % produces bread with good nutritious and quality attributes (Agrahar-Murugkar *et al*., 2015; Emmanuel *et al*., 2010). The composite blend of rice + corn + cassava flours obtain gluten-free bread with satisfying flavor, appearance, and well-structured crumb. Gluten-free products are highly demanding from the market point of view and also demand of busy lifestyle of humans. Different hydrocolloids and gums are available at the market level for the fabrication of gluten-free bread and are also used for generating the same polymer network addressed by wheat gluten proteins. Mainly the gluten-free bread is created by using several combinations of cellulose derivatives (Abdelghafor *et al*., 2011). The buckwheat flour used in composite flour for product manufacturing is a superior one as compared to wheat flour, as it reported with higher lysine, iron, magnesium, calcium, and copper constituents. The polyphenols rutin, catechins have potential antioxidant activities and these functional compounds of buckwheat reported great health benefits such as lowering cholesterol level decreases blood pressure, control blood glucose level and also reduce the risk of cancer (Emmanuel *et al*., 2010). The bread prepared by both barley + defatted soy flours at 15 % is regarded as acceptable, nutritionally, and organoleptically as they have a high amount of proteins, dietary fibers, lysine, minerals, and β-glucan. Legume flours are used in baked products to attain protein-enriched products with amino acid balance. The main property of legumes is that they have a high content of lysine, essential amino acids. Mainly the legumes reported for product production are soybean, chickpea flour, germinated pea flour, and lupin flour (Abioye *et al*., 2011). The nutritional composition of various composite flours are summarized in Table 2.

Rheological and functional aspects of various composite flours

The constituents which influenced the functional properties of flours are carbohydrates, proteins, fats, moisture, fiber, ash, and other ingredients. Functional properties are the main quality characteristic among all attributes of flour for infants, preteens, teens, and adult foods (Awuchi *et al.,* 2019). The science of flow and deformation of the matter is known as rheology and it also illustrates the interrelation between force, deformation, and time. Moreover, to anticipate the processing behavior of flour the most efficient way is the characterization of rheological prosperities of dough (Moradi *et al.,* 2016). Chandra *et al.* (2015) stated that a combination of wheat flour with rice flour, green gram flour and potato flour used to prepare the composite flour and the ratios used for composite flours were 100:0:0:0 (W100), 85:5:5:5 (W85), 70:10:10:10 (W70) and 55:15:15:15 (W55) respectively. The enhancement in the integration of other flours with wheat flour significantly increases the functional properties of composite flours such as swelling capacity, water absorption capability, emulsion activity, foam capacity, foam stability, gelatinization temperature, and bulk density. Noorfarahzilah *et al.* (2014) studied that valuable consideration to obtain good quality food products in terms of aesthetic appeal, sensory evaluation, and consumer approval is functional properties.

Besides, the incorporation of wheat flour with other flours such as buckwheat flour, chickpea flour, cornflour, soybean flour, taro flour, rice flour, black bean flour demonstrated a considerable effect on functional properties (bulk density, emulsion capacity, foaming capacity, oil absorption capacity, water absorption capacity) of the flour blends as well as their finished products. Prajapati *et al.* (2015) reported that grouping of wheat flour with other flour such as mushroom flour, black gram flour, soya flour, and sorghum flour in ratios of 100:0:0:0:0, 90:2:5:2:5:2:5:2, 80:5:0:5:0:5:0:5:0, and 70:7:5:7:5:7:5:7:5 orderly. The ratio of 100:0:0:0:0 was used as the control for wheat flour. Furthermore, with the rising level of incorporation the functional properties like swelling water capacity, water absorption capacity, and foam stability were also increased whereas foam capacity, oil absorption capacity, emulsion stability, and bulk density decreased. Meka *et al.* (2019) investigated the functional properties of non-wheat composite flour samples that were prepared with yellow maize, jackfruit seeds, and soybeans with the ratio of 80:20 (sample A), 75:20:5 (sample B), 70:20:10 (sample C), 65:20:15 (sample D), 60:20:20 (sample E), 55:20:25 (sample F). Additionally, functional properties of all flour samples explained bulk density varied from (0.57-0.68 g/cm3), viscosity (97.80-114.67 mPa.S), swelling capacity (6.05-8.84), water absorption capacity (5.09-9.04 g/g), oil absorption capacity (1.3-2.26 g/g) correspondingly. Deshpande *et al.* (1983) examined functional properties such as water and oil absorption, foaming capacity and stability, and emulsifying activity of composite flour prepared by fortification of wheat flour with six bean flour. The functional properties of composite flour increased with increasing the level of beans flour in the mixture. Similarly, the pasting properties of composite flour had increased as compared to wheat flour which was measured by Brabender Viscoamylograph. Julianti *et al.* (2017) researched that the rheological properties of composite flour were remarkably manipulated by the addition of sweet potato flour, maize starch, soybean flour, and xanthan gum. Moreover, peak viscosity, hot paste viscosity, and cold paste viscosity were considerably reduced with the boosted level of soybean flour in composite flour. Malomo *et al.* (2011) reported the rheological characteristics of composite flour from breadfruit, breadnut, and wheat and the study showed protein content (9.50-10.50 mg/100g), water absorption capacity (62.90-72.30%), and dough stability time (7.50-12.00 min).

Rustemova *et al.* (2020) explored the rheological properties of composite flour of wheat and amaranth flour. The water absorption ability of flour increased 4.5 times with an increased level of food fibers in the blend. Likewise, it was also illustrated that the baking process is also influenced by water absorption capacity. Ndayishimiye *et al.*, 2016; Murekatete *et al.*, 2014 studied the rheological properties such as elasticity, dough stability, and viscoelastic properties of composite sweet potato-wheat dough. The viscoelastic properties were checked by a controlled-stress rheometer. Seyam and Kidman, 1976 inspected the rheological attributes of numerous blends of composite flour from wheat and rice flour. When the rice was added at a 40% level, the farinograph absorption reduced while the mechanical tolerance index got increased. In the same way, dough stability development time, arrival time, and overall farinogarph scores were also decreased. As a result, at 40% level of rice addition weakened the dough. However, the acceptable quality dough was obtained when rice was added at a 25% level. Karaoglu, (2012) showed that the rheological factors such as dough resistance, area, ratio number, and rhefermentometer attributes as Hm, T1, Tx, volume loss, and gas retention significantly increased with the addition of whole and defatted Ceohalariasyriaca flour in wheat composite flour. On the contrary, the farinogarh parameters are negatively affected by the addition of Cephalariasyriaca. Codina *et al.* (2019) verified the falling number for the wheat-flaxseed composite flour. The study showed that the falling number increased with the increased level of flaxseed in the composite flour.

Health benefits of various composite flours

Composite flour has a considerable amount of phenolic acid (ferulic acid, benzoic acid, sinapic acid, diferulic acid, p-coumaric acid) and it also playsan important role to prevent cancer, diabetes, and cardiovascular disease. Moreover, composite flour significantly reduces the serum glycosylated protein level, lipoprotein cholesterol, glycosylated albumin level, and serum lipid level (Mughal, 2019). Waleed *et al.*, 2017 and Noorfarahzilah *et al.*, 2014 studied that production and consumption of functional composite flour enhance the dietary quality and nutritional aspects of flour. However, it also helps people suffering from degenerative diseases related to contemporary lifestyles and surroundings. Bhatt and Gupta, (2015) investigated phenols and flavonoids in raw composite flour (sorghum, whole wheat flour, chickpea, sprouted wheat, and sprouted barley) with the help of chromatography techniques (HPLC and GCMS). High-performance liquid chromatography was used to analyze flavonoids (rutin, quercetin, epicatechin, and chlorogenic acid) and Gas chromatography-mass spectrometers were utilized to identify secondary metabolite, vitamin E, and hexadecanoic acid. Besides, secondary metabolite compound contributes high antioxidant and therapeutic prosperities in the composite extract of flours.

Dalal and Bobade (2018) reported that composite flour consists of wheat, soy, and oat satisfy the increasing demand fora healthy diet. Wheat flour is an excellent source of protein, oat flour has a high amount of phytochemicals, dietary fibers, and lipid, soya flour is a substantial source of calcium, vitamins (A, D, B, and C) high-quality protein, and balanced amino acids. Consequently, multigrain incorporation of these flours could supply numerous kinds of health benefits such as support healthy digestion, prevent obesity and increase bone strength. Similarly, Sturza *et al.*, (2020) assessed that raw materials like buckwheat and sprouts flour used for the production of bakery goods were valuable, as it improves the nutritional profile of bakery goods. Additionally, buckwheat is a good source of bioactive compounds for example phenolics and flavonoids, which show several affirmative impacts on consumers' health and sprouts are also a great source of proteins, fibers, vitamins, minerals, and bioactive compounds. Therefore, sprout improves digestibility and also enhances antioxidant activity. In developing countries, millet-based composite flour using skimmed milk powder and vegetables have the potential to make a significant contribution to the enhancement of nutrition of children (6-59 months). The use of skimmed milk powder and vegetables improves the macronutrient, micronutrient content, and quality of protein of millet-based composite flour (Tumwine *et al.*, 2019). Divakar and Prakash, (2021) examined that composite flour containing whole grain and millet-based composite flour was a wealthy resource of nutrients such as protein, fat, dietary fiber, and bioactive compounds. Composite flour contained high protein content, essential amino acid, polyunsaturated fatty acid, monounsaturated fatty acid, and bioactive components such as total phenols and total flavonoids. Thus, this kind of flours is used in the development of nutritious products for all age groups. Verem *et al*., (2021) studied that composite flour prepared with refined wheat flour, soy flour, and moringa leaf flour develops the nutritional value of the product, provides health benefits to consumers, and also reduces the reliance on wheat flour. Likewise, composite flour obtained from coconut and defatted fluted pumpkin seed flour could be used as the best source of nutrient enhancement in baked products. There are abundant health potentials of coconut flour such as prevention against strokes, reduces blood pressure, and balance blood sugar level and insulin level. Furthermore, fluted pumpkin seed flour helps to decrease protein-energy malnutrition in school children and adults (Oyet and Chibor, 2020). Bello *et al*. (2017) considered that mushroom is an excellent source of minerals. As a result, mushroom enhances the mineral content of mushroom-wheat composite flour. The biscuit sample obtained from mushroom-wheat composite flour contained helpful minerals that are necessary for regular body performance. On the other hand, some minerals are in trace amount for instance manganese, copper, and zinc and these kinds of minerals are essential for good health and biochemical purposes till death. Akinjayeju *et al*. (2020) explored functional dough meal prepared from cereal-based soy-fortified flours has glycaemic and anti-diabetic properties in diabetic induced rats. Verification also revealed that this type of flour contains bioactive compounds, protein, fiber, and phytochemicals which enhances metabolic activities, improve digestive health, balances blood sugar level, and reduces bad cholesterol level. Besides, the replacement of cassava flour with dehulled soybeans improves the mineral content of maize, cassava, and soybeans composite flour. It also reduces the anti-nutritional properties of maize, cassava, and soybeans composite flour. The adequate amount of soybean flour used in composite flour encouraged to increase the nutritional and health quality of local flours. Khan *et al*. (2012) reported wheat-soy composite flour chapattis have anti-cancer and anti-diabetic properties and it also boosts digestive health, enhances heart health, increases metabolic activities, and improves bone health. Composite flour from pearl millet and pumpkin fruit improves the nutritional status of normal flour. This flour increases lactation and helps in relieving menstrual cramps (Kindiki, 2017). The health benefits of various composite flours are discussed in Table 3.

Anti-nutritional factors

Composite flours are rich in valuable nutritional compounds with good content of carbohydrates, lipids, proteins, fibers, minerals, and vitamins. Legumes used in flours are peas, lentils and beans are rich in minerals like calcium, iron, zinc, magnesium, and potassium. Legumes are reported as good for health as they control the cholesterol level of the body and also diabetes, cancer, and heart diseases. Cereals like rice, wheat, and maize are rich sources of minerals, vitamins, oils, fats, carbohydrates, and proteins (Famakin *et al*., 2016). Despite all these positive effects the presence of anti-nutritional factors in these components causes limited their applications in food ingredients and products and also reported with various health concerns. Anti-nutritional factors are naturally occurring compounds these cereals, legumes when are ingested they affect nutrients of the human body especially to vitamins, minerals, and proteins, and hence, causes reduction of their absorption in the gastrointestinal tract (Kindiki, 2017). Some anti-nutritional factors are phytate, phenolic compounds like tannins, lectin, oxalate, and enzyme inhibitors like trypsin, amylase, saponins reported from different flours. Most of the anti-nutritional factors affect the digestive system of the human body. Proteases reported from legumes cause inhibition of pancreatic serine proteases and tannins causes' reduction of amino acids bioavailability as well as affects protein digestibility. The negative effect of these anti-nutritional factors is controlled by various processing techniques by lowering and removing the effect of these compounds before consumption. To enhance the nutritional quality of legumes, cereals treatments like thermal, enzyme application, soaking, irradiation, sprouting, and fermentation are common. Also, cooking at high temperature remove the effect of anti-nutritional factors (Butt *et al*., 2007).

Toxicological effects

Toxicological effects are called the exposure duration of toxins and the concentration of chemicals within the target organ. Cereals flours are reported with aflatoxins (AFs) and ochratoxin A (OTA) that causes heart problems, blood pressure increase, and skin-related problems (Mughal, 2019). The harmful effect of wheat gliadin reported in coeliac disease was due to the glutamine content present in high amounts. Cassava flour contains gluco-cyanide that is toxic in nature by enzymelinamarase it undergoes hydrolysis process and results in hydrogen cyanide. Direct consumption of cassava produces dangerous effect and have cyanogenesis problem. Other toxic effects reported from legumes-based flours are goitrogenic factors, cyanogenetic glucosides, saponins, and alkaloids (Geetha *et al*., 2020).

Role of various composite flours in managing lifestyle disorders

In the contemporary era, everyone becomes health conscious so the demand for functional food increasing day by day and growing awareness of therapeutic foods reveals that some ailments could be controlled by a precise diet. Oluwajuyitan and Ijarotimi (2019) reported that composite plantain-based dough meal prepared by fortification of legumes, cereals, and pulses with plantain flour enhances the nutritional superiority and protein content of products. Moreover, plantain flour-based product manages diabetes, reduces the blood glucose level and lower starch digestion rate in the body. Famakin *et al*. (2016) investigated the glycemic index, antidiabetic properties, and protein digestibility of the plantain-based dough meal was determined in Wister rats. The rats fed with the composite flour significantly lower the glycemic index, glycemic level, and blood glucose level as compared to synthetic anti-diabetic drugs such as cerolina and metformia. Geetha *et al*., (2020) explored that millet-based blend had the appropriate level of protein and dietary fiber and the addition of millet-based flour in dose, mudde and roti indicate that it could considerably lower the glycemic index and load of three developed products. Similarly, low glycemic index foods are in demand nowadays, because they holdup the release of glucose in the body. Mughal, (2019) accounted that composite flour maintains the physical property of arterial walls, suppressing the beta lipoprotein-C oxidation and proliferation of aortic smooth muscle cellular phones which appreciably reduces the glucose level and avoids heart attack. Combined flour significantly declines the serum glycosylated protein level, lipoprotein cholesterol, and serum lipid level. Besides, consumption of arabinoxylan fiber noticeably controls the glucose level in the blood, enhances the sensitivity of insulin, improves the efficiency of insulin, and prevents beta-cell damage. Butt *et al*., (2007) examined the hypocholesterolemic and hypoglycemic aspects of pectin, guar gum, and wheat-based composite flour chapattis. The four different treatments of composite flour were prepared such as (T0) wheat flour, (T1) wheat flour with 3% pectin, (T2) wheat flour with 3% guar gum, and (T3) wheat flour with 2% of pectin and guar gum respectively. The Streptocotocin-induced diabetic male albino rats were fed with composite flour chapattis and after consumption of this, the sample of blood was collected and analyzed which indicated that the rats consumed T2 sample showed momentous lessening in blood glucose about 17% after that T1 control nearly 10% of blood glucose and T3 9.24% in comparison of control (T0). Furthermore, the result showed that composite flour chapattis were capable to reduce blood cholesterol by approximately 18, 16, and 12% and decline blood triglyceride levels around 16, 12, 2% by T2, T3, and T1 orderly, in contrast, to control. Bouhlal *et al*. (2019) highlighted that lentil-wheat flour enhances the nutritional quality of the product. The highest ratio of lentil flour in wheat flour extensively increases the value of protein, ash, fat, and energy. Therefore, the addition of lentil flour is an excellent choice to managing protein malnutrition and deficiency regarding iron and zinc. Feyera, (2020) discovered that cereal and legume-based composite flour has numerous kinds of bioactive compounds which help in reducing the occurrence of various ailments such as cancer, diabetes, obesity, and cardiovascular diseases. This composite flour is also helpful for patients with type 2 diabetes mellitus and consumption of cereal-based flour assist in maintaining BMI (Body mass index). Hence, it reduced the risk of obesity. Olagunju, (2019) assessed that composite flour consists of grains and plants was rich in antioxidants. The investigation demonstrated that grain-plant-based composite flour could prevent insulin resistance by which the chances of diseases like type 2 diabetes, obesity, and cardiovascular disease become low. Similarly, passion fruit pericarp was rich in dietary fibers and flavonoids. Beneficial effects of passion fruit pericarp-based flour such as it manage obesity, glucose homeostasis, appetite, dyslipidemia. Researchers reported that 30g of passion fruit pericarp-based flour per day for 30 days was helpful to treat HIV patients. Moreover, 150g of passion fruit pericarp-based flour per day for 4 weeks was useful to treat asthma patients (Preedy and Watson, 2019). Stefoska-Needham *et al*., (2015) accounted that sorghum-cereal-legume-based food possesses enormous nutritional properties because it has an abundant amount of antioxidants and phytochemicals such as phenolics, flavonoids, and minerals. Likewise, precious knowledge highlights the importance of sorghum-cereal-legume-based flour as it manages hazards related to recent altering lifestyles and surroundings such as non-communicable ailments, degenerative diseases, metabolic disorders.

Composite flours available in the market commercially

There are various kinds of composite flour blends launched in the market by food industries, health experts. These functional flours possess several types of beneficial properties, which reduce the risk of undernourishment and assured syndromes in children and adults (Sharma *et al*., 2018). There are so many well-known brands that sell composite flours for product formation such as a ashirvaad atta, laxmibhog atta, shakti bhogata, annapurana farm-fresh atta, fortunechakki fresh atta. The products related to composite flour, which obtainable commercially are cakes, cookies, beverages, noodles, pasta and macaroni. Cereal based alcoholic beverages based on raw material such as wheat-based beverages (Takju, SourichShchi, Boza), Rice-based beverages (Shaosinghjiu, Chongju, Sake, Kvas, Takju), Maize based beverages (Chicha, Sora, Sekete, Boza), Millet based beverages (Thumba, Jaanr, Burukutu), Sorghum based beverages (Gowe, Merissa), Sorghum based beverages (Beer, kvas, SourichSchi) are available in the market (Bhalla *et al*., 2009). However, numerous kinds of non-alcoholic cereal-based beverages are also available commercially, for instance- rice koji based beverage (Amazake), wheat bran, corn flour-based beverage (Bors), rice or millet-based beverage (Busa), maize-based beverage (Munkoyo), bulgur flour-based beverage (Shalgam), Maize and finger millet based beverage (Tobwa), pearl millet meal and sorghum-based beverage (Ontaku) (Ignat *et al*., 2020). Moreover, merged flour noodles and pasta are also accessible in the market, for examples- organic 100% chickpea and soybean spaghetti noodles, organic 100% green dal and edamame spaghetti noodles, buckwheat gluten-free pasta (De Arcangelis *et al*., 2020; Natow and Heslin, 2008; Garcia-Valle *et al*., 2021). Furthermore, instant porridge prepared by wheat, millet, maize, soybean, and amaranth flour is marketable around the world under the brand name Nutreal. Additionally, high fiber brown bread are also available in the market which consists of maida and wheat flour.

Future prospective

The production of innovative food products using composite flours is gaining the attraction of scientists and researchers especially for bakery goods and pastries manufacturing due to the bioactive constituents, health benefits, and nutritional composition of composite flours. Composite flours produced products still not able to maintain the characteristics both functionally and nutritionally as the products reported from whole wheat flour. The utilization of composite flour is a new and unique approach for the utilization of uncommon food products and crops for product preparation with good health benefits reported. The composite flour is enriched with bioactive compounds and has good nutritional composition. Many products are available at the market that is produced from composite flours but still, many underutilized plants can be used for composite flours incorporation. More exploration is required in this field in the future to have good evidence for composite flours fabrication for usage at bakery and pastry industries.

CONCLUSION

The composite flours addition into bakery goods is to enhance the physicochemical and functional aspects of bakery products. The different flours including soy flour, soybean, oat, lentils, chickpea, maize, rice, gram, etc. have good essential amino acids, calcium, iron, protein, and other essential compounds which have health benefits on our body. This review brings insights into different composite flours for the production of bakery and pastry products to improve the nutritional and quality attributes of products. Composite flours improve the nutritional status of the population and help to avoid sufferings from different diseases that are occurred due to changing lifestyles and environment. These composite flours not only improve the health status but also manage lifestyle disorders including lowering cholesterol level, blood glucose level, avoid the risk of cancer proliferation and other degenerative diseases. The present review provides the nutritional value of composite flours, their importance, managing disorders, and other properties of composite flours.

Table 1 : Various types of flours for product development are described above

Sr No.	Types of Flour	Product Reported	Significant Findings	References
1.	Wheat flour (100:0:0:0)+ rice flour(85:5:5:5) + green gram flour(70:10:10:10) + potato flour (55:15:15:15)	Biscuits	• Good swelling capacity • Water absorption capacity • Oil absorption capacity • Emulsion stability • Foam stability • Effective for malnutrition children's	Chandra *et al.*, 2015
2.	Wheat flour (85:70:60) + Soy flour (5:10:14) + sprouted mung bean flour (5:10:13)+ mango kernel flour (5:10:13)	Bread	• Significant functional • Physico-chemical • Organoleptic attributes	Menon *et al.*, 2015
3.	Chickpea (10:5) + sorghum (10:5) + buckwheat (10:5)+ Sprouted wheat (10:5) + sprouted barley (10:5) + corn flour (10:5) + Defatted soy (10:5)	Bread	• Good water holding capacity • Oil holding capacity • Water absorption capacity • Increases nutritive value	Bhatt and Gupta, 2015
4.	Rice flour (30:30:30:30:30:30:30:30:30) + cassava flour (50:45:40:45:40:35:40:35:30) + soybean flour (15:20:25:15:20:25:15:20:25) + potato starch (4.5:4.5:4.5:9.5:9.5:9.5:14. 5:14. 5:14.5)	Bread	• Dough have good water absorption index • Good oil absorption index • Swelling power	Tharise *et al.*, 2014
5.	Finger millet (10:20) + Wheat flour (10:20)	Biscuits	• Good water absorption & solubility index • Increases nutritional aspects of product	Krishnan *et al.*, 2011
6.	Wheat flour (80:90:80:75) + full fat soy flour (10:10:10) + chickpea flour (20:10:10)	Missi roti/ Chapatti	• Good textural properties • Increases nutritional value • Avoid malnutrition & other diseases	Kadam *et al.*, 2012
7.	Whole wheat flour (90:80:70) + finger millet flour (--:10:20) + defatted soy flour (10:10:10)	Noodles	• Healthy & nutritious product	Vijayakumar *et al.*, 2010
8.	Rice flour (10:20:30:40) + wheat flour (10:20:30:40)	Sponge cakes	• Increases functional & nutritious aspects • Enhance overall acceptability of product	Ju *et al.*, 2006
9.	Sweet potato flour (0:15:20:25) + wheat flour (100:85:80:75)	Madiga	• Improved nutritional qualities • Avoid malnutrition disorder	Idolo, 2011
10.	Seaweed powder (2:4:6:8) + wheat flour (100)	Bread	• Improves textural properties • Improve water absorption index	Mamat *et al.*, 2014
11.	Wheat flour (100:90:90:90:80:80:80:70: 70:60: 60:60) + mushroom flour (0:5:0:10:10:5:15: 10:20:20:10:30) + cassava flour (0:5:10:0:10:15: 5:20:10:20:30:10)	NA	• Good absorption index • Dough have good strength & hardening capacity	Ekunseitan *et al.*, 2017
12.	Acha flour (100:90:80:70:60:50) + Malted soybean flour (0:10:20:30:40:50)	Biscuits + Bread	• Good sensory properties • Improved nutritional value	Ayo *et al.*, 2014
13.	Wheat flour (100:95:90:85) + Acha flour (100:95:90:85) + cowpea flour (0:5:10:15)	Bread	• Enhanced textural properties • Good sensory properties	Olapade andOluwole, 2013
14.	Wheat flour (90:80:70) + Taro flour (10:20:30)	Bread	• Improved swelling capacity • Oil absorption capacity • Water holding index	Emmanuel *et al.*, 2010
15.	Oat: Sorghum flour: amaranth (Mix flour) (0:5: 10:15: 20:25) + wheat flour (100:95:90:85:80:75)	Cookies	• Low cost product with desired textural properties	Raihan and Saini, 2017
16.	Pigeon pea flour (0:25:50:75:100) + wheat flour (100:75:50:25:0)	Biscuits	• Healthy product with high nutritional values	Gbenga - Fabusi wa *et al.*, 2018
17.	Brown rice flour (0:5:10:15:20) + Wheat flour (100:95:90:85:80)	Biscuits	• Enhanced swelling capacity • Foaming capacity • Improved nutritional value of product	Islam *et al.*, 2012
18.	Wheat flour (70:50) + Hemp (5:10) + Barley flour (30:50)	Cookies	• Enhanced nutritional quality • Improved overall acceptability of product	Hrušková and Švec, 2015
19.	Wheat flour (100:90:80:70:60:50:40:30:20) + cassava flour (0:10:20:30:40:50:60:70) + soybean flour (0:0:0:0:0:10:10:10)	Biscuits	• Desirable organoleptic qualities	Oluwamukomi *et al.*, 2011

Table 2. Nutritional composition of various composite flours

Composite flour	Nutrient (g/100g)				Vitamins & Minerals (Nutrient (mg/100g)									References
	CHO	Protein	Fat	Fiber	B1	B2	B6	C	Ca	Fe	Mg	Na	K	
Wheat flour	76.0	10.2	1	2.7	5.35	Not reported	0	0	15	1.2	22	2	107	Kumar *et al*., 2011, Kulkarni *et al*., 2012, Shewry and Hey, 2015
Rice Flour	80	6	1.4	2.4	0.14	0.01	0.4	0	10	0.4	35	0	76	Verma and Shukla, 2011, Chusak and Adisakwattana, 2020
Soybean Flour	32	38	21	10	Not reported	Not reported	0.5	0	206	6.4	429	13	2,515	Sharma *et al*., 2014, Taghdir *et al*., 2017, Hassan, 2013
Cowpea Flour	57.17	25	1.63	14.2	0.21	1.09	1.0	58.3	36.0	276	80.2	27.2	1309	Ahmed *et al*., 2012, Da silva *et al*., 2018, Romuald *et al*., 2017, Gondwe *et al*., 2019
Oat flour	66.30	16.90	6.90	10.60	0.76	0.13	0.12	0	54	5	1.77	0.00	429	Sterna *et al*., 2016, Litwinek *et al*., 2021, Youssef *et al*., 2016, Rasane *et al*., 2015
Sorghum flour	74.68	12.25	4.24	1.71	0.32	0.06	0.32	0	3.75	2.24	75.02	6.2	350	Mohammed *et al*., 2011, Kulamarva *et al*., 2009, Khalil *et al*., 1984
Finger Millet Flour	66.8	7.16	1.9	10	0.37	0.17	0.05	0	364	4.62	146	6	443	Audu *et al*., 2018, Ramashia *et al*., 2019, Gull *et al*., 2014
Chickpea Flour	58	22	7	11	0.45	0.1	0.45	0	45	4.9	166	64	846	Hirdyani., 2014, Harsha., 2014, Kishor *et al*., 2017
Corn Flour	79	7	1.8	3.9	0.17	0.15	0.32	0	3	1.1	32	7	142	Rybicka *et al*., 2017, Qamar *et al*., 2017, Grossmann *et al*., 1998
Buckwheat Flour	84.7	15.1	3.7	12	0.37	0.22	0.33	0	49.2	4.9	301	13.2	692	Wronkowska *et al*., 2010, Li and Zhang., 2001, Bonafaccia *et al*., 2003
Mushroom Flour	81.03	14.7	2.2	0.9	0.07	Not reported	0.1	2	116.2	7.73	Not reported	856.2	31,30	Farzana *et al*., 2019, Ibrahium and Hegazy, 2014, Bello *et al*., 2017
Green banana flour	85.2	4.12	0.7	15.4	0.18	0.24	0.26	19.7	16.01	2.19	84.51	4.7	307.5	Bezerra *et al*., 2013, Menezes *et al*., 2011, Suntharalingam and Ravindran, 1993, Gibert *et al*., 2019

Table 3 : Health benefits of various composite flours

Composite Flour	Potential health benefits	References
Wheat flour	• Reduce the risk of heart attack • Anti-diabetic • Lower the risk of obesity • Support healthy digestion • Anti-oxidant	Akhtar *et al*., 2011, Okartr and Liu, 2010, Sudha *et al*., 2007
Rice flour	• Anti-allergic • Improve digestive health • Enhances liver health • Maintain bone and skeletal health • Boost immune system • Natural exfoliant	Chinma *et al*., 2015, Kraithong *et al*., 2018, Klunklin and Savage, 2018
Soybean flour	• Anti-cancer • Improves bone health • Anti-diabetic • Boost digestive health • Enhance metabolic activities • Enhance heart health	Friedman and Brandom, 2001, Barnes, 1998, Omwamba and Mahungu, 2014
Cowpea flour	• Control blood cholesterol • Anti-cancer • Treat cardiovascular diseases • Anti-diabetic • Enhance hair growth	Jayathilake *et al*., 2018, Awika and Duodo, 2017, Udeogu *et al*., 2014, Liyanaga, 2014

	• Delay ageing signs	
Oat flour	• Anti-diabetic • Reduces bad cholesterol level • Anti-oxidant • Prevent constipation and diarrhea • Suitable for celiac patients	Mitra *et al*., 2012, Santhi and Kalaikannan, 2014, Zhu *et al*., 2020
Sorghum flour	• Inhibit tumour growth • Provide strong bones • Helps in weight control • Anti-diabetic • Anti-oxidant • Hypocholestrolemic effect • Staple food for celiac patients	Taylor and Emmambux, 2010, Chung *et al*., 2004, Kamath *et al*., 2004
Finger Millet flour	• Treat coronary artery disorder • Prevent celiac ailment • Helps in relieving menstrual cramps • Control diabetes • Increase lactation • Treat anemia • Increase bone strength	Ramashia *et al*., 2019, Devi *et al*., 2014, Shobana *et al*., 2013
Chickpea flour	• Reduce cholesterol • Anti-diabetic • Detoxifies sulphites • Boost immunity • Induce peaceful sleep • Good fiber source • Good for heart • Aids in weight loss • Control blood sugar	Jukanti *et al*., 2012, Rachwa-Rosiak *et al*., 2015, Johnson *et al*., 2005, Man *et al*., 2015
Corn flour	• Helpful during pregnancy • Energy booster • Helps in preventing Haemorrhoids • Anti-cancer • Anti-diabetic • Anti-oxidant • Help in preventing anemia	Plate and Gallaher, 2005, Siyuan *et al*., 2018, Pastor *et al*., 2015
Buckwheat flour	• Reduce risk of gallstones • Improves digestion • Prevents heart attack • Prevent asthma • Manages diabetes • Low in fat	Kaur *et al*., 2015, Ahmed *et al*., 2014, Sensoy *et al*., 2006

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