# FORTIFICATION OF FLAT GREEN BEANS (*PHASEOLUS VULGARIS*) POWDER FOR THE DEVELOPMENT OF READY TO COOK EXTRUDED PRODUCT: A REVIEW

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## Abstract

In the growing world, the necessity and demand for ready-to-cook extruded food matrix increasing day by day. Extrusion cooking technology is widely applied to the development of instant food matrix. Its advantages of low cost, sustainability, and flexibility for the production of ready-to-cook food products. In today's world, Extruded products are popular instant foodstuff. Some extruded products are categorized under the category of pasta, macaroni, vermicelli that are made from semolina. To develop the nutrient-rich extruded product and increase the number of vitamin A, vitamin C, vitamin K, and vitamin B9 and dietary fiber, flat green beans (*Phaseolus vulgaris*) are fortified with extruded products. These nutrient-rich extruded products were an honest source of nutrients for the consumers.

Keywords: Fortification, flat green beans *(Phaseolus vulgaris)*, ready-to-cook extruded products, extrusion

## 1)Introduction

Within the growing world, extrusion cooking one of the fastest-growing and most important food processing operations (Paton and Spratt, 1984). Currently, consumers demand nutritious food that has health benefits. Food industries developed functional food that contains high nutritive enriched ingredients that impact positive health benefits beyond the fundamental nutritional function. These ingredients or components are associated with disease prevention and improvement of quality of life. Some eatable cereals are processed grains suitable for human consumption without requiring further cooking. The cold extrusion process is run at a traditional temperature or marginally elevated temperature (Boyaci et al., 2012). Within the extrusion process, the merchandise extruded without frying, cooking, coloring, and distortion of the food (Harper, 2019). It doesn't produce pasta, vermicelli, hot dogs, pastry doughs, and some varieties of confectionery (Best and E.T., 1994). Extruded products are a typical food in Italy and are often produced by subjecting semolina water dough to either extrusion or lamination to urge the desired shape (Carini et. al, 2009). The water status of fresh cold extruded products affected by the shaping process. Extruded products (macaroni, pasta, vermicelli) kind of unleavened dough, mostly of durum, rarely buckwheat flour, water, and sometimes eggs, then extruded in various shapes and sizes. Pasta products are available in many shapes and sizes (Manthey et. al, 2005). Cold extruded products stored at frozen, chilled, or ambient temperature.

Wheat could also be a standard source that provides such types of shapes and sizes as macaroni, spaghetti, vermicelli, tagliatelli, noodles, and lasagna (Tudorica et al, 2002). Scarlet runner beans or flat green beans occur wild from Mexico. These beans originated from the species Papilionaceae (Leguminosae - Papilionoideae, Fabaceae) (Singh et. al, 2001). Nowadays, scarlet runner bean is cultivated in temperate countries and often in highland areas of Central and South America, Africa, and Asia. In Central America, immature and mature seeds are consumed. The assembly of flat green beans in India is 2334.32 tonnes (APEDA,2015-16). In temperate regions, the immature pods are most commonly eaten, sliced and cooked, as a vegetable. In India, growing up as a field crop in Madras, state, Karnataka, Madhya Pradesh, and Maharashtra. Green pod yield varies from 5-8 tonnes/hectare. Scarlet Runner beans readily cross-pollinate, so that they have to be isolated to possess seed from heirloom varieties come true. The edible flowers have a bean-like flavor and should be utilized in salads. The green pods are edible until they become fibrous, and will be boiled, steamed, or baked. Scarlet runner bean or flat green beans contain water 91.2g, energy 93kJ (22 kcal), protein 1.6g, fat 0.4g, carbohydrate 3.2g, dietary fiber 2.6g, Calcium 33mg, Magnesium 19mg, Phosphorus34 mg, Iron1.2 mg, Zinc 0.2mg, Carotene 145mg, thiamin 0.06mg, riboflavin 0.03mg, Vitamin B3 trace, and ascorbic acid 18mg/100g edible portion (Holland, Unwin & Buss, 1991). Young pods of Flat green bean cooked or fried with sliced onion and garlic, or utilized in salads. The usually flat green beans are eaten boiled either as a cooked vegetable or cold as a salad after cooking and adding oil and vinegar. By the use of flat green beans to supply fortified extruded products to extend the nutritional value of the products (Anton, et al., 2009) (Table 1.1).

Table 1.1: Nutritional values semolina and scarlet green beans per 100g

| Nutrients | Value per 100g | |
|---|---|---|
| | Semolina | Scarlet runner bean |
| Energy | 360calories | 22Kcal |
| Carbohydrate | 73g | 3.2g |
| Fat | 1.1g | 0.4g |
| Protein | 13g | 1.61g |
| Dietary Fibre | 3.9g | 2.6g |
| Calcium | - | 33mg |
| Magnesium | - | 19mg |
| Phosphorus | - | 34mg |
| Carotene | - | 145µg |
| Ascorbic acid | - | 18mg |
| Thiamin | - | 0.06mg |

## 2)Vermicelli

Vermicelli is also a standard type of extruded product during a bit almost like spaghetti. In Italy vermicelli is slightly thicker than spaghetti, but within the employment, slightly thinner (Alexander, D., 2000; Diner and H.R.,2009). The term "vermicelli" is additionally doesn't describe various forms of thin noodles in Asia (Fu and B.X., 2008). Vermicelli could be a popular ready-to-cook foodstuff that prime in proteins and made from semolina and water (Lorusso and A. V., 2015). It's one of all the foremost preferred ready-to-cook items in both Indian and foreign markets. With the rapid urbanization and growth of the economy, the demand for healthy and straightforward to arrange food products has reached sky-high (Krishnan et al., 2012). This makes the vermicelli making the business a perfect business opportunity to grab on because the demand for the identical is in an exceedingly highly growing trend. Vermicelli contains have a coffee amount of dietary fiber and water-soluble vitamin (Choo et al., 2010). The nutritional value of vermicelli (Table1.2) (Mogra R., and Midha S., 2013).

Table 1.2: Nutritional values of Vermicelli approx per 100g (USDA National Nutrient Database for Standard 2000)

| **Nutritional values** | **Per 100g** |
|---|---|
| Energy | 381kcal |
| Proteins | 10.5g |
| Total Carbohydrates | 82.5g |
| Dietary fiber | 2.5g |
| Total fat | 1g |
| Saturated fatty acid | 0.2g |
| Polyunsaturated fatty acid | 0.6g |
| Monounsaturated fatty acid | 0.1g |
| Trans-fatty acid | 0g |
| Sodium | 0g |
| Cholesterol | 0mg |
| Calcium | 3mg |
| Iron | 3mg |
| Vitamin A | 0mg |
| Vitamin C | 0mg |

## 3)Macaroni

Macaroni also an extruded product in a very section of a hollow tube and round tube. In Italy, it's a cuisine product for the buyer. Macaroni is created out of semolina and water. Macaroni served as ready-to-cook products (Lorusso and A. V., 2015). The nutritional value of macaroni (Table 1.3).

Table 1.3: Nutritional values of macaroni approx per 100g

| Amount per 100g | |
|---|---|
| Calories 371 | |
| | % Daily Value* |
| Total Fat 0.9 g | 1% |
| Saturated fat 0.2 g | 1% |
| Polyunsaturated fat 0.3 g | |
| Monounsaturated fat 0.1 g | |
| Trans fat 0 g | |
| Cholesterol 0 mg | 0% |
| Sodium 1 mg | 0% |
| Potassium 44 mg | 1% |
| Total Carbohydrate 31 g | 10% |
| Dietary fiber 1.8 g | 7% |
| Sugar 0.6 g | |
| Protein 6 g | 12% |

| | | | |
|---|---|---|---|
| Vitamin A | 0% | Vitamin C | 0% |
| Calcium | 0% | Iron | 2% |
| Vitamin D | 0% | Vitamin B-6 | 0% |
| Cobalamin 0% | | Magnesium | 4% |

## 4)Flat green beans puree

Flat green beans puree value-added fortified extruded product vermicelli and macaroni, the use of flat green beans is that the most vital aspect of this study. Flat green beans belong to the speciesPapilionaceae (Leguminosae - Papilionoideae, Fabaceae) (figure 1).

Figure 1: Flat green bean puree

Flat green bean puree, remaining after juice extraction, is that the primary waste fraction amounting to almost 50% of the fruit mass (Đilas et al., 2009). The Flat green bean puree having vital nutrients and certain beneficial properties that affect the gastrointestinal tract's function well (Pal et al., 2012). The waste by-product of Flat green bean is employed as a valuable functional food (Block et al., 1992).

## 5)The strategy of fortification to reduce micronutrient deficiency

Fortification of food decreases the micronutrient deficiency (MNDs) from the definite group of the inhabitants and improves the well-being of humans (Barker et al., 2018). There are four specific strategies to reduce MNDs such as dietary improvement, supplementation, food fortification, public health, and other control measures (Tulchinsky., 2010). Short term strategy such as nutrient supplement has been effective in providing immediate relief (Varady et al., 2019). Another strategy is a fortification of staple foods with micronutrients to improve public health in developing countries (Akhtar et al., 2011).

## 6) Extruder and its effects

Extrusion cooking is done by hot extrusion and cold extrusion. Hot extrusion may be a high-temperature short-time process that specifies the utilization of extreme temperature and pressure to create expanded products. Cold extrusion may be a low-temperature long-time process that refers to the merchandise is extruded without distortion and cooking of food. It enables the production of food and offers uniformity to the ultimate product. It destructs certain present toxins (Gaikwad et al., 2018). It reduces the activity of microorganisms from the ultimate product, denaturation of protein, and degradation depends on several parameters like temperature, light, time, pH, moisture (Nikmaram et al., 2015). Furthermore, there are variable changes during extrusion thanks to the vast deviation composition and chemical structure of vitamins, thermal degradation of the foremost factors within the loss of β-carotene. Small changes in these variables can affect the standard and characteristics of the ultimate product (Ajita., 2018).

## 7)Value addition of traditional wheat flour ready-to-cook extruded products

By using whole or refined wheat (durum) flour new product is developed named ready-to-cook extruded product (vermicelli, macaroni, pasta, and noodles). The hard dough is ready, extruded, and dried within the sun (Mogra et al., 2013). because of the deficiency of lysine (essential amino acid) in flour, the protein quality remains poor and reduces nutritional value(Graham et al., 1969). Therefore, improving the nutrient content of ready-to-cook extruded products the worth addition is mandatory to save lots of its delicacy (Sathya A., 2018). within the growing world, functional food products are very demandable in food markets. because of having insufficient time, ready-to-cook products play a significant role in the standard of living. There are several forms of variations of ready-to-cook food products that were prepared using whole flour (WWF); malted flour (MWF); malted flour, green gram, spinach, and sago (MGSS) (Teradal, D., 2013). A spice mix containing powders of tomato, coriander, chilies, turmeric, salt, raw mango powder, black pepper, cloves, and asafetida was also prepared. Recent articles sowed that, the general satisfactoriness scores for. On 9 point hedonic scales, WWF, MWF, and MGSS were 7.3 ± 6.13, 6.5 ± 0.06, and 8.1 ± 0.01. WWF, MWF, and MGSS contained 6.9

to 7.7% of moisture, 9.3 to 13.5% of protein, 1.2 to 2.7% of fat, 2.9 to 5.8% of ash, 2.2 to 2.4% of crude fiber, 69.8 to 75.2% of carbohydrates, and 344 to 362 kcal/100 g of energy, respectively.MWF ready-to-cook product (vermicelli) had the very best amount of total (8.91%), reducing (2.41%) and non-reducing sugars (6.57%). As regards minerals, in MGSS, higher contents of sodium (100 mg), calcium (30 mg), iron (5.9 mg), and zinc (1.4 mg) were found. The time of Vermicelli is 2 months period at temperature (25–30 °C) (Mogra et al., 2013). consistent with the study of addition of more pumpkin powder increased the extent of -carotene within the pasta. Amylo graph maximum viscosity and temperature and Farino graph water absorption and stability decreased because the amount of carrot puree increased. Pasta made with more carrot puree had a more enhanced color than those with less carrot puree. Cooked weight and volume were increased by 37% and 59% respectively. Fortification of carrot puree (5% ) was added to the flour sample ends up in gumminess level is low, while fortification of carrot puree (10% ) leads to low chewiness and hardness in macaroni.

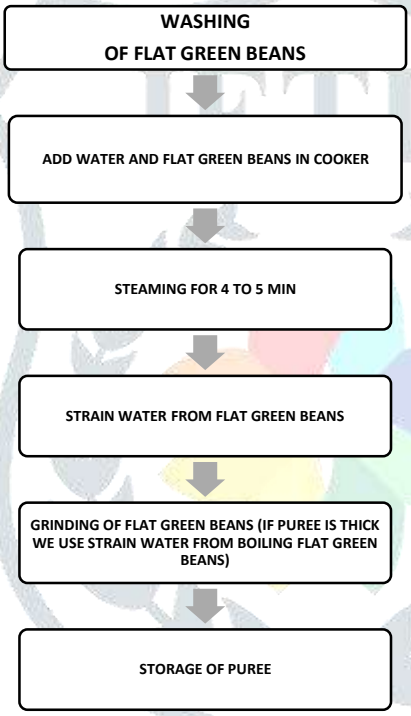


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**Figure 2: Procedure of preparing flat green beans puree**

## 8)Nutrient-rich ready-to-cook extruded products with Malted Finger Millet Flour (Ragi)

Recently, challenges are made to develop nutrient-rich ready-to-cook extruded products by the addition of wheat and malted ragi flour in numerous proportions (90:10 80:20, 70:30, 60:40, and 50:50) for optimization of ratio for production of higher quality ready-to-cook extruded products. It was observed that among all the formulations tried, the ready-to-cook extruded products sample prepared with 70:30 (wheat: malted ragi flour) combination had a similar sensory score as that of control. Higher values of protein, fiber, and minerals such as calcium, iron, and phosphorous than the control sample were reported in ready-to-cook extruded products samples incorporated with 30% of malted ragi flour (Lande et al., 2017). These nutrient-rich ready-to-cook extruded products were a decent source of minerals to the consumers (figure 3) (Kulkarni et al., 2012).

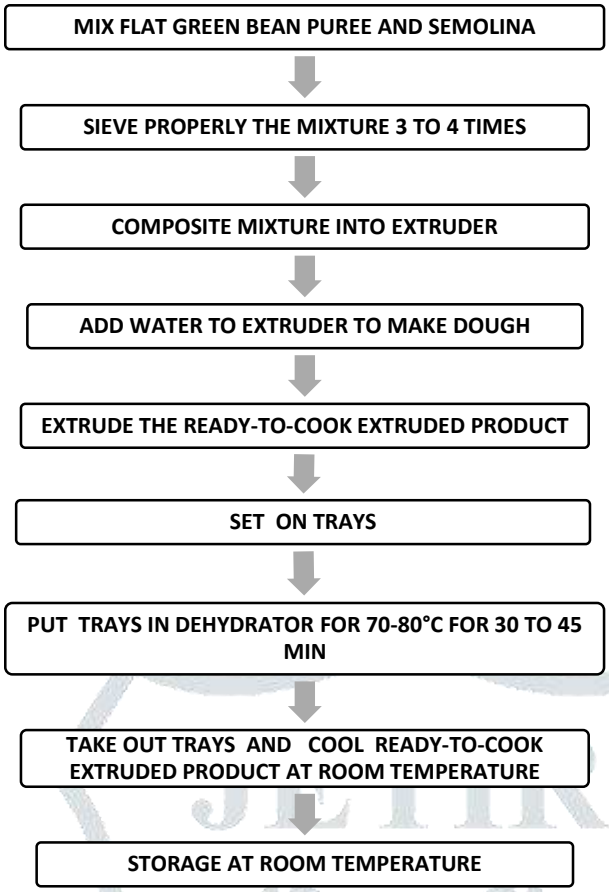


**Figure 3: Processing of Flat green bean ready-to-cook extruded product**

## 9)Health benefits of fortified flat green beans ready-to-cook extruded products

Being a food-based approach fortified food or functional food has several health benefits and advantages over other interventions, deliver a sufficient amount of carbohydrates, vitamins, proteins in assigned proportion to the recommended daily allowance(RDA) (Suchdev et al., 2020). Fortified foods or functional food are rich in nutrition (vitamins, minerals, healthy fats, and fiber) that protect against nutrient deficiency and neutralize harmful or toxic compounds like free radicals, prevent cell damage, improve growth factors, and certain chronic diseases like cardiovascular disease, cancer, tumor, and diabetes. Fortified food promotes proper growth and development to the buyer (Choudhary et al., 2009). Fortified green bean products are low in calories and stuffed with antioxidants, including ascorbic acid, flavonols, quercetin, and kaemferol. These antioxidants fight free radicals within the body, that reduce cell damage and should help to lower your risk of certain health conditions.

1) Improve Heart Health and Protect Gut Health

   To improve heart health and protect gut health, soluble fiber may help by lowering the cholesterol level and keeps the digestive system healthy and running smoothly. Green beans are full of fiber, that an important nutrient source. Fortification of green beans is done to reduce hunger and addition of flavor in the extruded product. It also controls cholesterol levels, digestive disorders like irritable bowel syndrome, bloating, and intestinal discomfort and prevents heart and gut diseases. It also boosts health functions and reduces inflammation (Guillén et al., 2017).

2) Aid in a Healthy Pregnancy

A single cup of green beans has approximately one-third of your daily recommended intake of folate, Vitamin B necessary for the growth and development of unborn babies. It helps to reduce the risk of certain birth defects. During pregnancy need to take more folate for the better development of a baby. According to RDA (Recommended Daily Allowance), pregnant women need 600mcg folate, and adults need 400mcg folate respectively (Delchier et al., 2012).

3) Protect Bone Health

Green beans are high in vitamin K and contain less amount of calcium. These nutrients are important for maintaining strong, healthy bones and reducing your risk of fractures (Ige., 2012).

4) Reduce Depression Symptoms

Flat green beans having a Vitamin B complex to reduce depression. Intake of sufficient folate helps to reduce the amount of homocysteine in the body. The high amount of homocysteine can interfere with the natural production of serotonin, dopamine, and norepinephrine, hormones that regulate the mood as well as sleep and appetite (Annerbo., 2012).

5) May Help with Anemia

Iron is an essential part of red blood cells that transport oxygen from the lungs to the other cells of the body. Insufficient iron intake can lead to anemia, that characterized by fatigue and weakness. Green beans provide a decent source of plant-based iron that can help to avoid anemia (Bauman and E H., 2017)

6) Promote growth and development

Nutrients are essential for the proper growth and maintenance of the body, some nutrients are essential and others are non-essential. Essential nutrients cannot be synthesized by the own body that consumes by the regular diet. For proper growth and development, several essential nutrients are vitamins, minerals, protein, fat, and carbohydrate that consumed by a good diet. For example, cereals fortified with folic acid that is essential for fetal health, omega-3 fatty acids, iron, zinc, and calcium can be fortified into the food to improve the properties of the food (Huma et al., 2007).

6.1) Infants

Micronutrient deficiencies are more common in infants as their small stomach requires well nutrient-dense food to sustain their growth (Briend A., 2001). Breast milk is best for infants for their initial growth and development, due to lactose intolerance baby does not digest the milk, and some mothers cannot breastfeed due to several reasons. Therefore, food fortification is good in such cases and some fortified foods are made for infants such as cerelac (Martin et al., 2016).

6.2) Adults

As they grow they choose tasty food instead of nutrient-based food, avoids vegetables, and fruits. However, many of the adults not getting enough nutrition such as calcium, magnesium, dietary fiber, and vitamins (A, D, E, K, and C). For example, soy milk rich in protein and

fortified with calcium, whole grains bread rich in folate (vitamin B), skim milk is fortified with vitamin A and vitamin D, whole grain cereals are fortified with vitamin B6, B12 (Miller et al., 2001).

## Conclusion

We concluded that it has been made to develop nutrient-rich ready-to-cook extruded products by the fortification food for optimization of incorporation of flat green beans for production of better quality ready-to-cook extruded products. To ensure sustainability in the resource for poor countries, and implemented in concerned with poor people, poverty. It has been developed higher values of, fiber, vitamin A, vitamin C, vitamin K, folic acid ready-to-cook extruded products. These nutrient-rich ready-to-cook extruded products were a good source of vitamin C, vitamin K, vitamin A, vitamin $B_9$, and dietary fiber to the consumers.

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