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Development of Food Products by using *Capsicum chinense* Jacq (King Chilli)

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ABSTRACT

A food product using *Capsicum chinense* Jacq. (King chilli) was developed to standardize different products by using king chilli, and to study overall acceptability, chemical characteristics, and shelf- life stability of the developed products. Two products namely King chilli puree (KCP) and Leftover king chilli pickle (LKCP) were developed from king chilli and tomato with three formulations under each products. The acceptability trials was conducted after each formulations using nice point hedonic scale. Out of all the formulations, KCP3 exhibited highest scores for all the sensory attributes with an overall acceptability score of 8.80. Thus, KCP3 were selected for carrying out further analysis. Nutrients content of the KCP3 products were moisture (96.51g/100g), total ash (0.22g/100g), fat (0.41), protein (0.79g/100g), carbohydrate (2.07g/100g), energy (15.1kcal), and vitamin C (ascorbic acid) (210.75mg). The shelf life and the sensory scores of the formulation remain intact in all the sensory attributes at 45 days of storage and the microbiological quality was under food low allowance of Hazard Analysis Critical Control Point (HACCP) due to king chilli`s anti-bacterial substance. The nutrition education program and demonstration was conducted with a major objectives of entrepreneurship development to encourage people to grow and developed products from king chilli. As the development and utilization of such functional ingredients will enhance the overall health of the population as well as prevent the various life-threatening diseases, such as cancers, cardiovascular diseases, asthma, arthritis and also help in the economic development of the king chilli growers.

***Key words*:** King chilli, King chilli puree, Leftover king chilli pickle, Nutrition education program, Functional ingredients

King chilli belongs to the Genus Capsicum and species chinense. It is famous for its heat content and was announced as the world's hottest chilli in the world by Guinness book of world record (2006). King chilli is traditionally cultivated in Assam, Nagaland, Manipur and other North Eastern States of India [1]. It measures 60 to 85 mm long and 25 to 30 mm wide with red, yellow, orange or chocolate colour [2]. The extreme character of this chili is due to the volatile phenolic amine 'capsaicin and dihydrocapsaicin' which is responsible for the pungency found mainly in the placenta as well as fleshly tissue of the fruit [3].

King chilli have been incorporated into a number of medicinal preparations in the ancient literature around the World [4], it contains various biologically active components with physiological and biochemical functions which play a key role in human health [5]. It has been reported that capsaicin present in king chilli helps in reducing inflammatory heat, pain from rheumatoid arthritis, represses the growth of various malignant cell and may prevent various diseases associated with Cardiovascular system, cancer and neurological diseases [6-7]. It is also used as traditional medicine for the treatment of ulcers, diabetes [8], headache, night blindness, rheumatism, arthritis, gastritis, ankylosing spondylitis, digestive diseases [9] and to reduce chronic congestion [10]. Besides imparting pungency and red colour to the dishes, they are a rich source of vitamin A, C and vitamin E (tocopherol) and assist in digestion and are also a source of proteins, minerals, oleoresin and red pigment. Chillies are widely used as spices, condiments, culinary supplements, medicine, vegetable and ornamental plants too. It forms an important ingredient in day-to-day curries, pickles, chutneys and oleoresin [11]. Although king chilli is having a great demand and are consumed highly in North Eastern States of India but storing of this crop is very challenging due to its perishability [12]. Keeping these in view, a study was planned on "Development of food products by using *capsicum chinense jacq.* (King chilli)" to increase the

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storage life by studying the chemical composition of the developed products and to study overall acceptability and storage stability of the developed products.

MATERIALS AND METHODS

Selection of samples

For carrying out the present study required samples were procured from the local market of Imphal (Ima keithal bazaar) Manipur, district of Imphal West and Guwahati, Assam.

Pre-processing of raw materials

The stem and bruise part of raw ingredients were removed for the safety of product development.

Formulation of king chilli products

The products were developed from raw king chilli and different methods shown in (Fig 1-4) below:

Fig 1 Formulation of king chilli purees

Fig 2 Formulation of king chilli pickles

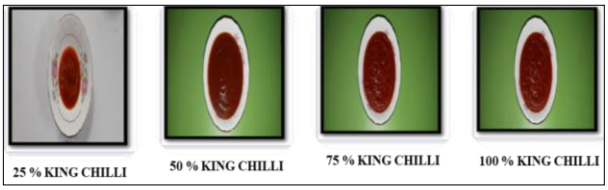


Fig 3 Formulation of king chilli sauces

Fig 4 Formulation of king chilli dry flake

For the development of king chilli sauces, the procedure of tomato sauce was used from the guideline of FPO to prepared king chilli sauces. The king chilli sauces were developed into three products at different level of incorporation i.e.

Sensory analysis

King chilli products and its three variations of were evaluated for acceptability semi-trained panel members.

Nutrient analysis

The variations of products namely King chilli puree (KCP), Leftover king chilli pickle (LKCP), king chilli sauce (KCS) and king chilli dry flakes (KCDF) were analyzed for moisture, mineral, vitamin C, crude protein and crude fat following the standard A.O.A.C (2000) [13] method. Total carbohydrate content was determined by phenol sulphuric acid method [14]. The energy value was determined by multiplying the percentage of crude protein, crude fat and carbohydrate by the calorific value of these three i.e., by the factor 4,9 and 4 respectively and the estimation was recorded as kcal per 100g [15]. And to determine total soluble solids measurement of the refractive index of the test solution at 20°C, using a refractometer, and use of tables correlating refractive index with soluble solids content (expressed as sucrose), or direct reading of the soluble solids content on the refractometer [16].

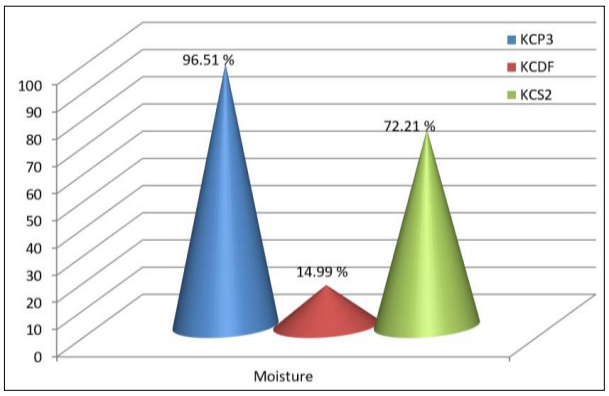
Shelf life of the developed products of King chilli

To determination of colony (microbes) present in developed product serial dilution agar plating method or viable plate count method was used. This method for estimating microorganism was modified from Tate R. L. (1995) [17]. Soil Microbiology. John Wiley & Sons, New York.

RESULTS AND DISCUSSION

Nutrient composition of king chilli products

Moisture: The moisture contents of KCP3 (blanched king chilli puree), KCDF (king chilli dry flakes) and KCS2 (25% kind chilli sauce) are presented in (Fig 1).



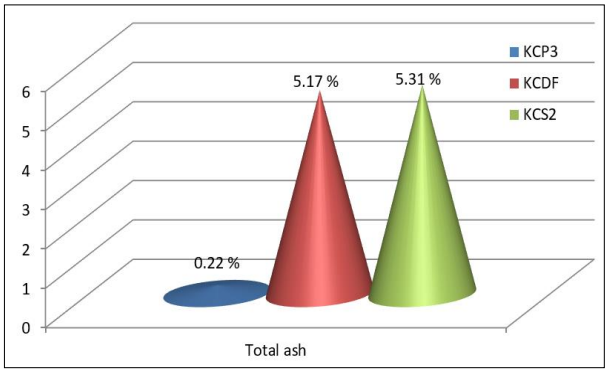
KCP3–Blanched king chilli puree, KCDF – King chilli dry flakes, KCS2 – 25% king chilli sauce
Fig 1 Moisture content of king chilli products

Table 1 Moisture contents of king chilli products

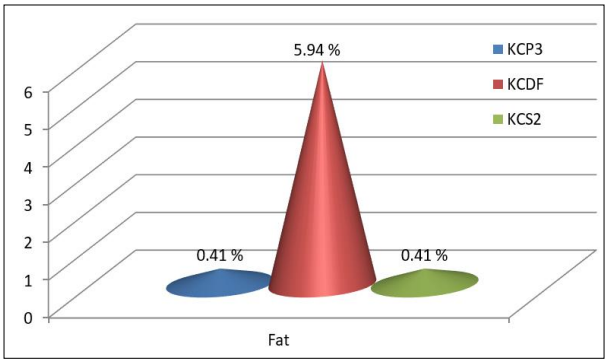
Moisture content	Percentage
Blanched king chilli puree	96.51g/100g (KCP3)
King chilli dry flakes	14.99g/100g (KCDF)
25% king chilli sauce	72.21g/100g (KCS2)

The moisture content of king chilli puree was highest than king chilli sauce and king chilli dry flakes due to the uses of water in preparation of puree. Also, nutritive value of chilli chart by National Institute of Nutrition (NIN) shows that the moisture content are higher in raw perishable chillies then dry chillies. During the drying process, moisture loss occurs due to the difference in water vapor pressure between the product and the air surrounding it also resulting in fewer nutritional and sensorial alterations [18] reported that the moisture content of dried chilli ranged from 10 to 14% which could retard colour loss. Moisture content lower than 8% could accelerate pigment destruction.

Total ash: The result of the total ash were presented in (Fig 2). It can be observed that the developed product of king chilli sauce are higher content of minerals than other two products. The data reveal that the ash content of king chilli products are 0.22g/100g (KCP3), 5.17g/100g (KCDF), and 5.31g/100g (KCS2). The increase in ash content in king chilli sauce may be due to the presence of minerals in tomato. The ash content in fresh peppers differed significantly from peppers subjected to drying, which may have resulted from the temperatures applied, which degrade the micronutrients represented in the analysis of the ashes [19].



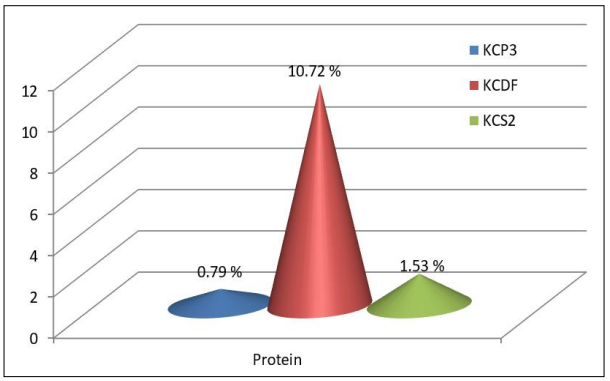
KCP3- Blanched king chilli puree, KCDF- King chilli dry flakes, KCS2-25% King chili sauce
Fig 2 Total ash content of king chilli products



KCP3- Blanched king chilli puree, KCDF- King chilli dry flakes, KCS2-25% King chili sauce
Fig 3 Fat content of king chilli products

Crude fat: The fat content of king chilli products are presented in (Fig 3). The data shows that 0.41g/100g (KCP3), 5.94g/100g (KCDF) and 0.41g/100g (KCS2) of fat was present. The product of king chilli dry flakes content high amount of fat more than chilli puree and chilli sauce. The result of the fat contain of dry chillies were slightly similar to the nutritional value of chilli chart given by National Institute of Nutrition (NIN) i.e., (6.200g/100g). According to [20] no treatment differed by the Tukey test ($P > 0.05$). This indicates the absence of fat degradation during drying. The present result was compared to the study done by Ananthan *et al*. [21], Malakar *et al*. [12] and was found that the amount of fat quantity in raw king chilli is (0.82g/100g) higher than process products.

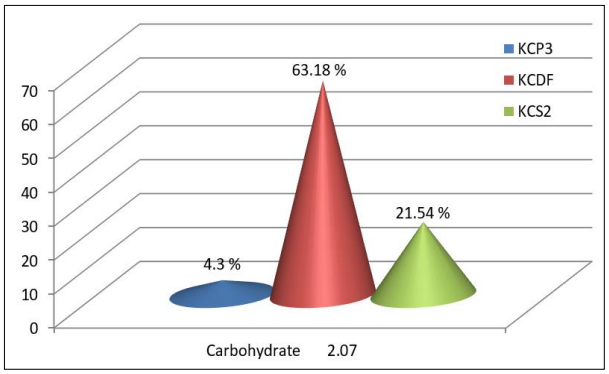
Crude protein: The crude protein content of king chilli products were presented in the given (Fig 4). KCDF contains highest amount of protein 10.72g/100g, and KCP3 0.79g/100g, KCS2 1.53g/100g. According to Morris *et al.* [22], heating generally improves the digestibility of foods, making some nutrients more available as in case of protein in legumes, which become more digestible after heating because of inactivation of anti- nutrient such as trypsin inhibitor.



KCP3- Blanched king chilli puree, KCDF- King chilli dry flakes, KCS2-25% King chili sauce
Fig 4 Protein content of king chilli products

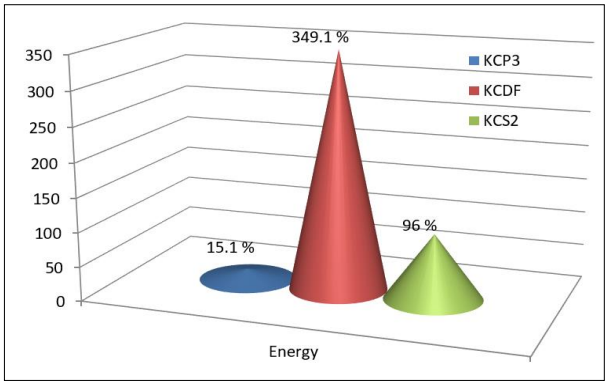
Carbohydrate: The carbohydrate content of king chilli products were presented in the given (Fig 5). The data revealed that KCDF contains highest amount of carbohydrate as compared to the other two chilli products. The amount of carbohydrate present are KCDF 63.18g/100g, KCP3 2.07g/100g and KCS2 21.54 g/100g. According to the study of [23] it was shown that chilli

powder recorded highest carbohydrate due to retention of volatiles and minerals in the samples.



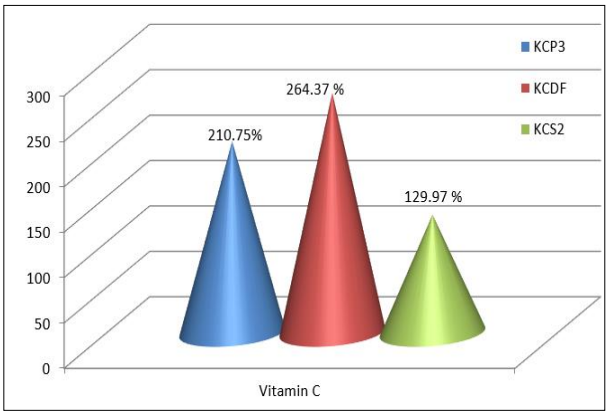
KCP3- Blanched king chilli puree, KCDF- King chilli dry flakes, KCS2-25% King chili sauce
Fig 5 Carbohydrate content of king chilli products

Energy: The energy contents of king chilli products are presented in the (Fig 6). The data shows that the energy content are KCP3 15.1 kcal/100 g, KCDF 349.1 kcal/100g and KCS2 96.0 kcal/100g. King chilli dry flakes yield higher amount of energy than the other two products.



KCP3- Blanched king chilli puree, KCDF- King chilli dry flakes, KCS2-25% King chili sauce
Fig 6 Energy content of king chilli products

Vitamin C (Ascorbic acid): The vitamin C content of king chilli products are presented in (Fig 7). The table shows the vitamin C present in the products are KCP3 210.75 mg/100g, KCDF 264.37 mg/100g, and KCS2 129.97 mg/100g. King chilli dry flakes contain higher ascorbic acid than other chilli sauce and chilli puree. In contrast with the result of the present study, [24] revealed that ascorbic acid content increased from green to red while, decreased in red partially dried and red fully dried fruits. Also, high content of ascorbic acid was pronounced in red ripening and most of the chilli peppers were fall under medium category of ascorbic acid content however, the lowest contents were recorded in red partially dried and red fully dried fruits. This may due to the decrease in the moisture content in fruits, similar view point is also by [25-27]. According to [28], the study revealed that the chemical composition of nutrients in red pepper puree were higher than tomato puree. Also, the amount of ascorbic acid in re d pepper puree were higher than tomato puree, these results were same in the present study that the amount of ascorbic acid in blanched king chilli were higher than in 25% king chilli sauce. According to the study of [29] and the result was indicates that the pepper containing high phenolics provides a source of antioxidants and in addition it improves flavour to food hence it is used as a value added ingredient for stabilizing food against lipid peroxidation reactions.



KCP3- Blanched king chilli puree, KCDF- King chilli dry flakes, KCS2-25% King chili sauce
Fig 7 Vitamin C (ascorbic acid) of king chilli products

Total soluble solids (TSS): Soluble solids content was determined at 20°C with a refractometer and reported as °Brix. The total soluble solid content in king chilli puree (KCP3) is 8 while total soluble solids in king chilli sauce contain 31 and king chilli pickle was not found any total soluble solid due to the uses of leftover in the products of king chilli puree and chilli sauce. According to the standard of HACCP, the total soluble solids of chilli puree and chilli sauce was accepted.

Table 2 Test of total soluble solid (TSS)

Products	Total soluble solid (TSS)
Blanched king chilli puree	8
25% King chilli sauce	31
Leftover seeds and peels king chilli pickle	Not detected

Shelf-life storage and microbial count studies of the developed products of king chilli

The shelf life of the formulated king chilli products were studied by storing the products in the plastic air tight container for a period of 0 day, 15 days, 30 days, 45 days and 60 days. The organoleptic evaluation was done at regular intervals of time.

Sensory evaluation over storage

The enjoyment of products is closely related to senses, and in the case of food, mainly taste, aroma and texture. Sensory evaluation is a dynamic field concentrating on the utilization of humans for the measurement of sensory perceptions and/ or their effects on food and taste acceptance [27]. Sensory evaluation was done in the Food Science Laboratory of the Department of Food Nutrition and Dietetics. Developed formulations were evaluated thrice for their sensory qualities by 24 semi train panel members selected from the Department of Food Nutrition and Dietetics, College of Assam down town University. Sensory attributes for the developed formulations were analyzed across storage upto 45 days. Judges were asked to score the products for each and every quality attributes i.e. colour, appearance, taste, texture, flavor, consistency and overall acceptability using a score card of nine Hedonic Rating Scale.

During storage for 3 months the colour of the products were decreasing the redness and become slightly dark in colour with increasing storage period related to some activity of natural enzymes, chemical reaction and activity of microorganisms. A similar result was found in a study by [28]), shows that the decreasing of discoloration, beta carotene, lycopene were increased with increasing storage time. This may be due to maillard reaction and ascorbic acid and pigment oxidation. The scores of king chilli products for colour, flavor, taste, texture and consistency were gradually decreased throughout the storage period from 30 days onwards, but none of the products were unacceptable.

Microbiological quality of developed products of king chilli

It is known that vegetable are frequently contaminated by large number of microorganisms especially spoilage type, and in some cases, pathogen microorganisms because of their contact with soil during cultivation and harvesting [31]. The microbiological quality of any foods is dependent on number of factors such as raw material and sanitation during preparation and storage temperature of products. The variation of pH and total acidity are possible due to various caused by contamination from microorganisms. Microorganisms, mainly lactic acid bacteria, produce organic acids, which then increase in total acidity content and decrease in pH value. Generally, sun dried chilli becomes more contaminated with microorganisms than in the other drying processes [32].

The microbiological quality of chilli samples are given in (Table 3-4). It was shown that microbiological quality found in some products was under the allowance of HACCP. Coliform group was not detected after three months storage in the product of king chili dry flakes but in chilli puree few were seen after 30 days of storage, in chilli sauce and chilli pickle no colony developed even after 45 days of storage [28], was also found that the lowest count was found in paste contained 10% of dried red peppers, this may be related to that a_w for dried red peppers not suitable for growing many of organisms opposite fresh tomato and red peppers. Coliform group was not detected after three months storage in king chili dry flakes but in chilli puree few colonies were seen after 30 days of storage, in chilli sauce and chilli pickle no colony developed even after 45 days of storage.

Table 3 Microbiological quality (cfu / ml) of food samples made from king chilli and tomato

Microbiological groups	Storage period (day/ month)	KCP3	KCP3	KCP3	LKCP	LKCP1	LKCP1
Total viable bacterial count	15 days	1×10^2 cfu/ml	3×10^2 cfu/ml	3×10^2 cfu/ml	1.1×10^2 cfu/ml	2×10^2 cfu/ml	2×10^2 cfu/ml
	30 days	2×10^2 cfu/ml	2×10^2 cfu/ml	ND cfu/ml	2×10 cfu/ml	1×10^2 cfu/ml	1×10^2 cfu/ml
	45 days	5×10 cfu/ml	6×10^2 cfu/ml	4×10^2 cfu/ml	1×10^2 cfu/ml	1.2×10^2 cfu/ml	3×10^2 cfu/ml

KCP3 – Blanched king chilli puree, LKCP1 – Leftover seeds king chilli pickle, ND – not detect

Table 3 Microbiological quality (cfu / ml) of food samples made from king chilli and tomato

Microbiological groups	Storage period (day/ month)	KCP3	KCP3	KCP3	LKCP	LKCP1	LKCP1
Total viable bacterial count	15 days	4×10 cfu/ml	3×10^2 cfu/ml	ND cfu/ml	-	-	-
	30 days	5×10 cfu/ml	ND	ND	3×10 cfu/ml	3×10^2 cfu/ml	2×10^3 cfu/ml
	45 days	1.5×10 cfu/ml	5×10^2 cfu/ml	3×10^3 cfu/ml	3×10 cfu/ml	ND	ND
	60 days	-	-	-	ND	ND	ND

KCP3 – Blanched king chilli puree, LKCP1 – Leftover seeds king chilli pickle, ND – not detect

CONCLUSION

It is concluded that the present study of the development of king chilli products can be made with combination of tomato like king chilli + tomato (puree), 25% king chilli + 75% tomato (sauce) and tomato with king chilli (pickle) without effecting the sensory attributes. The king chilli with tomato products are nutritionally superior to that of tomato products due to their large content of antioxidants and also king chilli have functional benefits of health promoting effects due to its high capsaicinoid content. The results of the present research can be used as a valuable information for development of king chilli products. Hence development and utilization of such functional ingredients will enhance the overall health of the population as well as prevent the various life-threatening diseases, such as cancers, cardiovascular diseases, asthma, arthritis. Extensive studies should be carried on animal subjects to validate the nutritional and preventive properties of king chilli.

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