Incorporation of Dried Fruit Powder into Cooked Mutton Patties and its Effects on Nutritional Qualities

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Abstract: **- the current era where meat products are gaining high value in the market has increased the risk of many diseases including cardiovascular diseases, cancer, diabetes, obesity etc. A diet rich in antioxidants and fiber can help prevent the risk of these diseases up to a certain level. In the following studies apples were peeled, pulped and dried in freeze drier. The meat patties were incorporated with apple peel, apple pulp and strawberry at 3%, 5% and 7% concentration in the powdered form. Incorporation of fruit powders significantly increased the moisture content and decreased the emulsion stability. Cooking yield of the products containing fruit powders at different concentrations was significantly lower ($p<0.05$) than the control. Also the nutritional analysis for carbohydrate, protein, fat and vitamin content was analysed where there was increase in carbohydrate and vitamin content and decrease in protein and fat content as compared to the control. The sensory analysis found better results for the patty incorporated with apple peel powder at 5% and was proved that the fruit powder did no harm in taste, quality and texture of the meat product.**

Keywords: Apple peel, Apple pulp, Strawberry, Mutton patties, Antioxidant activity, Dietary Fiber, Quality

I. INTRODUCTION

"An apple a day keeps the doctor away" holds true to many cases. Fruits like apples and strawberries that have been termed as super foods for their high antioxidant content and disease reducing or preventing capacity should be consumed daily[1]. Meat products are gaining high value in the market for its rich taste. The fatty acids in meat also undergo oxidation reducing the meat flavor, taste and nutritional value. Therefore this delay of oxidation is very much important in order to maintain the long shelf life of meat[2]. Oxidation leads to the production of free radicals which reacts with the muscles of the meat destroying protein and other nutrient content[3].

Apples are rich in carotenoids, vitamins, flavonoids and phytochemicals like quercetin, catechin, phloridzin and chlorogenic acid which are strong antioxidants. Apples are also rich in complex carbohydrates like dietary fiber and its incorporation in meat products has proven to be beneficial to health[4]. Also strawberries are considered to be "super foods" because of its antioxidant content. Not just do they increase the antioxidant effect in meat but also enrich their color. Strawberries contain antioxidants like vitamin C, and phenolic acids such as flavonols and anthocyanins. Important phenolics are the ellagitannins and ellagic acid[5]. Incorporation of fruits having several bioactive components in meat products would definitely enhance their physiological, functional and nutritional values[6].

The objective of this study is to study the effectiveness of the value addition of functional mutton supplemented with apple and strawberry powder and its effect on the nutritional characteristic of the product. With the incorporation of apple and strawberry extracts in mutton up to certain percentage along with the required spices, the possible outcomes that are expected are as follows: Improvement in texture, taste, overall acceptability, nutritional changes, increase in dietary fiber leading to a healthy edible meat.

II. MATERIALS AND METHODS

A. Raw materials

California apples and strawberries were purchased from the super market. The apples were peeled and the pulp was mashed in the mixer. The strawberry was also mashed in the mixer. They were kept for freeze drying in the presence of nitrogen for 24 hours. The dried samples were then powdered in the grinder and packed in LDPE and stored at $3^{\circ}C$[7].

Also goat meat without bone was purchased from the butcher shop. Mutton masala powder, salt, ginger-garlic paste and oil were purchased from the market. The meat was cooked to be softened. Then it was ground and minced.

B. Detailed study

After incorporating the fruit powder to the meat the following tests were conducted for the meat: carbohydrate test, protein test, fat test, vitamin C analysis, dietary fiber test, sensory and statistical analysis.

Formulation of mutton patties is done and given in table 1

C. Preparation of meat patties

Boneless meat was obtained from the market. The meat was cut into pieces and cooked in pressure cooker with NaCl to

soften it. Once the meat is softened grind it in the mixer and mince the meat. Spice mix and ginger garlic paste along with oil is added to the minced meat and mixed thoroughly. The minced meat is divided into batches of 50g each and a part is kept as the control where no fruit powder is added. The other 9 batches are assigned with the following treatments : apple peel powder at three different concentrations, 3%, 5%, 7%; apple pulp powder at three different concentrations, 3%, 5%, 7% and the same holds good for strawberry powder too. the meat is shaped into patties[9]. The different meat patties with different concentrations are packed in LDPE at 4C for later usage[10]

D. Protein Analysis by Kjeldahl method

Approximately 2g of the homogenized sample was taken into 300ml kjeldahl flask without wetting the walls of the flask. 25ml of concentrated sulphuric acid, 10g of anhydrous sodium sulphate and 0.2 g of copper sulphate was added. The content in the kjeldahl flask was digested at 80C for 5 hrs. The contents of the flask were allowed to cool. The sides of the flask were washed through a fine jt of distilled water and finally 50ml of distilled water was added and the salts were dissolved completely. The contents were cooled in ice water and quantitatively transferred it to a 1000ml distillation flask using not more than 300ml of distilled water. The cooled contents were transferred to the distillation flask and the contents were distilled till ammonia passes over into the acid. The distillate was then titrated with 0.1 N standard sodium hydroxide solution. The end point was the disappearance of pink colour and the titre value was noted[11]

Calculation : $\frac{\text{Blank titre} \times 0.14 \times 6.25}{\text{Weight of the sample}}$

Ingredients	Control	3%	5%	7%
Meat	50	50	50	50
Salt	1.5	1.5	1.5	1.5
Spice mix	2.2	2.2	2.2	2.2
Oil	4.3	4.3	4.3	4.30
Ginger garlic paste	4.5	4.5	4.5	4.5
Fruit powder	0	3	5	7

Table I Formulation of mutton patty

E. Fat estimation

5g of pre dried sample was weighed into an extraction thimble, with porosity permitting the rapid flow of solvent (n-hexane). The initial weight of flat bottom boiling flask was noted.. the soxhlet apparatus was assembled along with the flat bottom flask, and the extraction was started by heating solvent in boiling flask for 4hrs. After extraction the boiling flask was dried with extracted fat in the hot air oven at 100C for 30 minutes, cooled to room temperature in a dessicator and the final weight was noted[12]

Fat % = $\frac{(B-A)\times 100}{W}$

W = Weight of the sample in g

A = initial weight of flat bottom flask before extraction

B = final weight of bottom flask after extraction and drying

F. Carbohydrate Estimation

100 mg of the sample was weighed into a boiling tube. It was hydrolysed by keeping it in a boiling water bath for three hours with 5 mL of 2.5 N HCl and cooled to room temperature. It was neutralized with solid sodium carbonate until the effervescence ceases. The volume is made up to 100 mL and centrifuged. The supernatant is collected and 0.5 and 1 mL aliquots were taken for analysis. The standards were prepared by taking 0, 0.2, 0.4, 0.6, 0.8 and 1 mL of the working standard. '0' served as blank. The volume is made upto 1 mL in all the tubes including the sample tubes by adding distilled water. Then 4 mL of anthrone reagent is added. It is then heated for eight minutes in a boiling water bath. It is rapidly cooled and the green to dark green colour is read at 630 nm. A standard graph is drawn by plotting concentration of the standard on the X-axis versus absorbance on the Y-axis. From the graph the amount of carbohydrate present in the sample tube is added.

Calculation:

Amount of carbohydrate present in 100 mg of the sample = $\frac{\text{Mg of glucose x 100}}{\text{Volume of test sample}}$

G. Vitamin C Estimation

Ascorbic Acid content was estimated by Iodine titration method. Sample of 1g was taken and made upto 100 ml volume with 3 % HPO3 and filtered. Standard ascorbic acid solution was prepared by taking 50 mg ascorbic acid and making up its volume upto 50 ml with 3 % HPO3 solution; an aliquot of 5 ml from this solution was made up to 50 ml with 3 % HPO3solution. 42 mg of NaHCO3 was dissolved in 150 ml hot distilled water. 50 mg of the dye, 2, 6- dichlorophenol indophenol was added in it and the volume was made upto 200 ml with distilled water to prepare the Dye solution. 5 ml of standard ascorbic acid solution was taken and mixed with 5 ml of 3 % HPO3 solution. Dye was filled in a pipette and titration was done till a pink color appears that persists for at least 15 seconds. 5 ml of sample was blended with 50 ml of 3 % HPO3 solution and filtered. 2 ml was taken from this solution and titrated against the dye. Dye Factor is 0.5/Titre[13]. The calculations were done with the help of the following formula :

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{Titre} \times \text{dye factor} \times 100}{\text{Aliquot of extract taken} \times \text{weight of sample taken}}$$

H. Dietary Fiber analysis:

The dietary fiber in mutton patties were determined as per the method of AOAC (1995). Add 3 mL acetic/nitric reagent to a known amount (0.5 g or 1 g) of the sample in a test tube and mix in a vortex mixer. Place the tube in a water-bath at 100°C for 30 minutes. Cool and then centrifuge the contents for 15–20 min. Discard the supernatant. Wash the residue with distilled water. Add 10 mL of 67% sulphuric acid and allow it to stand for 1 h. Dilute 1 mL of the above solution to 100 mL. To 1 mL of this diluted solution, add 10 mL of anthrone reagent and mix well. Heat the tubes in a boiling water-bath for 10 min. Cool and measure the colour at 630 nm. Set a blank with anthrone reagent and distilled water[14]

I. Sensory analysis:

The sensory analysis for various samples were conducted for taste, aroma, texture and appearance. The sensory evaluations were conducted on nine point hedonic scale. The panelists were asked to rate the acceptability of the product on a scale of 9 points ranging from 9 to be "like extremely" to 1 to be "dislike extremely".

J. Statistical analysis:

3 experimental trials were conducted for each sample. Statistical analysis was done using SPSS version 20. Mean values were calculated using two way ANOVA. The statistical significance was defined at $p<0.05$. The values were presented as mean along with standard error (Mean ±Standard Error).

III. RESULTS:

A. Protein Estimation:

Fruit peels are an important source of bioactive compounds including Anti-oxidants, Proteins and Pectins. Protease enzymes help in break down of proteins. They aid in the process of digestion and metabolism, and also are recognized to strengthen the immune system by improving inflammation. Proteins are critical sources of nitrogen as well as sulfur and are essential dietary constituents. They are major structural components that providing mechanical support to the body known to be essence of life processes for proper growth and development of all the living beings. Protein deficiency may lead to a number of health disorders. Fruits are not major sources of protein as compared to other dietary supplements. Due to this the results have shown that there was a decrease in protein content during storage studies.

Days	Control	Apple Peel, 3%	Apple peel 5%	Apple peel 7%	Apple pulp 3%	Apple pulp 5%	Apple pulp 7%	Strawberry 3%	Strawberry 5%	Strawberry 7%
0	6.9±0.29	6.9±0.62	6.9±0.52	6.9±0.41	6.5±0.21	6.5±0.31	6.5±0.11	6.7±0.05	6.8±0.3	6.8±0.13
3	6.9±0.03	6.9±0.12	6.9±0.21	6.9±0.51	6.5±0.2	6.5±0.02	6.5±0.25	6.6±0.89	6.8±0.03	6.8±0.02
6	6.9±0.02	6.9±0.1	6.9±0.01	6.9±0.44	6.4±0.35	6.5±0.45	6.4±0.13	6.6±0.51	6.7±0.54	6.7±0.85
9	6.8±0.19	6.8±0.3	6.8±0.12	6.8±0.04	6.3±0.14	6.4±0.22	6.4±0.1	6.6±0.31	6.7±0.45	6.7±0.5
12	6.7±0.3	6.7±0.1	6.7±0.01	6.7±0.23	6.3±0	6.3±0.02	6.4±0.05	6.6±0.04	6.7±0.2	6.7±0.03

Table II: Protein values of mutton incorporated with fruit samples at different conc

B. Carbohydrate estimation

Apples and strawberries are the fruits containing healthy sugars with low glycemic index. This factor is very important as it helps in increasing the carbohydrates present in meat. Meat in general have extremely low carbohydrate. Addition of fruit powders have increased the nutrient value of carbohydrates in meat as compared to the control. Non-cellulosic neutral sugar composition of cell walls from seventeen fruit types were analysed during ripening. Galactose was the major non-cellulosic neutral sugar in cell walls of cucurbit and solanaceous fruit, xylose was the predominant non-cellulosic neutral component of berries.

C. Fat estimation:

Fat increases the energy density of foods, while fiber decrease energy density. A fruit has the greatest impact on energy density because it adds weight to food without increasing calories, thus decreasing energy density. Most fruits and vegetables are low in energy density because of their high fiber content and their low fat content. This in the long term can help in reducing the cholesterol content in meat. The results obtained show the reduction in fat content of meat due to the fruit powders and their activities.

D. Vitamin C analysis:

A vitamin C deficiency can have a number of detrimental health effects with scurvy being the most serious and well known. Vitamin C functions as a vital electron donor and is an important antioxidant. Antioxidants are key components in the prevention of oxidative damage to proteins and DNA. Oxidative damage is associated with the development of both mild and severe health conditions including cancer, diabetes, cardiovascular disease, arthritis, and cataracts. Incorporation of fruit powders into mutton patty increased vitamin C slightly. But further heating can degrade it. Hence incorporation is advised for cooked cold mutton meat.

E. Dietary fiber estimation:

The sample incorporated with apple peel had high content of dietary fiber with an average value of 3 different concentrations to be 8.1-9.1%. Sample incorporated with strawberry powder had dietary fiber in the range of 4.11-5.2% and the sample containing apple pulp had the least value with 1.5-2.47%.

Days	Control	Apple peel 3%	Apple peel 5%	Apple peel 7%	Apple pulp 3%	Apple pulp 5%	Apple pulp 7%	Strawberry 3%	Strawberry 5%	Strawberry 7%
0	17.7±0.29	18.7±0.0	18.8±0.32	19.8±0.41	18.5±0.21	18.4±0.31	19.4±0.11	18.4±0.05	18.3±0.3	19.2±0.13
3	17.4±0.03	18.6±0.1	18.7±0.21	19.7±0.51	18.4±0.2	18.0±0.02	19.22±0.25	18.3±0.09	18.2±0.03	19.1±0.02
6	17.1±0.02	18.4±0.1	18.4±0.01	19.5±0.44	18.3±0.35	17.8±0.45	18.93±0.13	17.93±0.51	17.82±0.54	18.71±0.15
9	16.8±0.19	18±0.3	18.0±0.12	19.1±0.4	17.93±0.14	17.3±0.22	18.52±0.1	17.6±0.31	17.51±0.45	18.0±0.5
12	16.7±0.3	17.9±0.1	17.8±0.01	18.8±0.23	17.3±0.45	17.2±0.02	17.1±0.5	17.4±0.4	17.3±0.2	17.9±0.03

Table III: Carbohydrate values of mutton incorporated with fruit samples at different conc

Days	Control	Apple peel 3%	Apple peel 5%	Apple peel 7%	Apple pulp 3%	Apple pulp 5%	Apple pulp 7%	Strawberry 3%	Strawberry 5%	Strawberry 7%
0	5.8±0.29	5.6±0.32	5.6±0.32	5.6±0.11	5.7±0.11	5.7±0.31	5.7±0.11	5.7±0.05	5.8±0.3	5.8±0.13
3	5.8±0.03	5.6±0.12	5.6±0.21	5.5±0.51	5.7±0.02	5.7±0.02	5.6±0.25	5.6±0.09	5.8±0.03	5.8±0.02
6	5.7±0.02	5.6±0.1	5.6±0.01	5.5±0.44	5.6±0.35	5.6±0.45	5.6±0.13	5.5±0.51	5.7±0.54	5.7±0.15
9	5.7±0.19	5.5±0.3	5.5±0.12	5.5±0.4	5.6±0.14	5.6±0.22	5.6±0.1	5.5±0.31	5.7±0.45	5.7±0.5
12	5.6±0.3	5.5±0.1	5.5±0.01	5.4±0.23	5.5±0.45	5.6±0.02	5.5±0.5	5.5±0.4	5.7±0.2	5.6±0.03

Table IV. Fat values of mutton incorporated with fruit samples at different conc

D	control	Apple peel 3%	Apple peel 5%	Apple peel 7%	Apple pulp 3%	Apple pulp 5%	Apple pulp 7%	Strawberry 3%	Strawberry 5%	Strawberry 7%
0	0	0.021±0.003	0.022±0.001	0.023±0.001	0.032±0.002	0.033±0.001	0.034±0.003	0.045±0.001	0.047±0.003	0.049±0.002
3	0	0.021±0.001	0.022±0.001	0.023±0.002	0.032±0.003	0.033±0.002	0.034±0.002	0.046±0.002	0.047±0.002	5.8±0.002
6	0	0.022±0.001	0.023±0.003	0.024±0.001	0.033±0.002	0.034±0.003	0.035±0.002	0.046±0.001	0.048±0.001	5.7±0.003
9	0	0.022±0.002	0.023±0.001	0.024±0.002	0.033±0.001	0.034±0.001	0.035±0.001	0.047±0.003	0.048±0.003	5.7±0.002
12	0	0.023±0.002	0.024±0.002	0.025±0.003	0.034±0.001	0.035±0.002	0.036±0.001	0.047±0.002	0.049±0.003	5.6±0.001

Table V. Vitamin C values of mutton incorporated with fruit samples at different conc

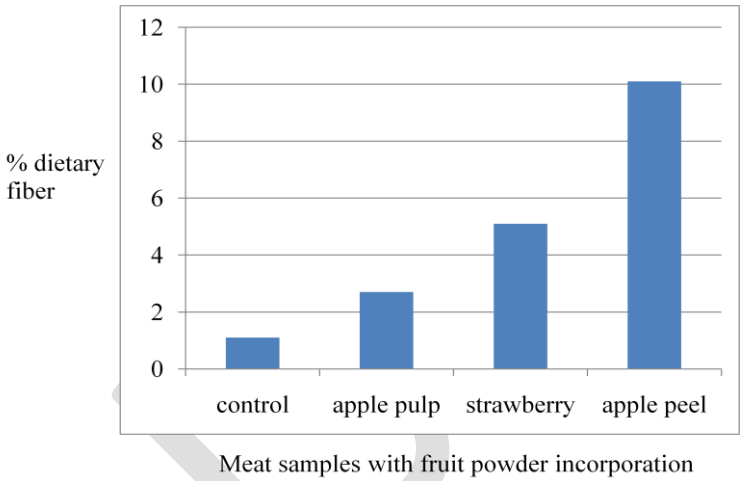

Fig 1 Comparative chart for the dietary fiber present in meat with different powders

F. Sensory Analysis

A panel of 10 members analysed the meat samples both stored and the fresh sample. It was found that overall acceptability was for the meat sample incorporated with apple peel at 5% with overall acceptability to be 8. There was no much difference between the acceptability rate of meat samples incorporated with apple pulp and strawberry powder at 3% whose acceptability was 7 and 6.5 respectively.

Sample	Color	taste	Aroma	Texture	Overall acceptance
Control	7	8	8	7	7.5
Apple peel (5%)	7.5	8	8	7.5	8
Apple pulp (3%)	7.5	7	6.5	7	7
Strawberry (3%)	7.5	6	7	6.5	6.5

Table VI Sensory analysis chart

IV. CONCLUSIONS

As per sensory analysis apple peel with 5% incorporation was found to have higher acceptance value. Also the dietary fiber was high in apple peel as compared to the other fruit powders. It was shown to have high antioxidant value almost equal to the strawberry powder with 7% incorporation. But the taste of strawberry powder was not acceptable in mutton patties and was highly acidic. The nutritional analysis for carbohydrate, protein, fat and vitamin content was analysed where there was an increase in carbohydrate and vitamin content and decrease in protein and fat content as compared to the control.This could be due to the presence of sugars and acids in food and the reduced content of protein and fat. And hence it can be concluded that apple peel incorporated in meat had better storage value and did not affect the product's organoleptic characteristics. Hence apple peel at 5% incorporation can be used as a source of antioxidant and dietary fiber in mutton patties and its application will be very valuable and desirable

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