Development and Performance Evaluation of prototype Soanpapdimaking Machine

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Abstract

In traditional practice of making soanpapdi, sugar pulling and twisting is done manually which is labour intensive, time consuming process. Handling sugar ball at high temperature, sugar pulling and twisting process is very difficult.To mechanize this process prototype soanpapdi making machine is developed and performance was evaluated in terms of time, capacity, threading efficiency and wastage. Less time taken, high capacity, minimum wastage and increased threading efficiency was observed in firm ball consistency and at 14 rpm speed of rotating table as compared to soft and hard ball sugar consistency. Maximum threading efficiency was achieved as 80% for the industrial formulation.

Key words: soanpapdi, capacity, threading efficiency, wastage, SEM

1. Introduction

Traditions are customs or beliefs taught by one generation to the next,often by word of mouth,and they play an inmportant role in cultural iden flourtification. Each culture, ethnic group or region has specific traditions.Some traditions such as religious customs overlap different cultures ethnic groups or regions. Specific eating habits plays animportantrole in the traditional habits of many cultures. The use of particular food ingredients and food preparation methods has been passed on from one generation to thenext, andnowadays referred to as 'Traditional foods'.A traditional food is a product frequently consumed or associated to specific celebration and seasons, normally transmitted from one generation to another, made with care in a specificway according to the gastronomic heritage with little or no processing that is distinguished and known because of its sensory properties and associated to a certain local area, region or country (Vanhonacker,2008).Soanpapdi is a traditional sweet and it has a crisp and flaky texture and it is made with sugar,besan flour, maida flour and fat. It is flavoured with cardamon and rose water and garnished with toasted pista and almond,which undergoes many rheological changes from conversion of sugar to flakes.Soanpapdi making process involves many problems such as pulling and twisting of sugar which is a tedious,time consuming and labour intensive alsodeprived quality and not a hygienic practice. Hence prototype soanpapdi making machine was developed and performance was evaluated.

Candy and confectionary making machines

Warning *et al.,* (1975) invented a cotton candy making machine in which sugar is collected in rotating collection pans from which it automatically feeds on to a conveyor belt which carries it through a compacting and sizing unit then through a cutter.John.T Sullivan *et al*., (1988) designed the cotton candy making machine which consist of floss head assembly which consist of upper and lower chamber that are adapted to melt two different color of sugarfor making stripe of cotton candy. Tsumita*et al*., (1989) invented a cotton candy machine which is provided with a rotating pan and a heating element which is disposed adjacent a bottom of the rotating pan and being rotatable with rotating pan.electricsupplyprovided to heat the heating element to melt the sugar and the melted sugar is discharged and cooled to form cotton candy in a cotton like form.Yamamoto*et al*., (1989) installed a fan forto produce air flow to a rotary member. Bandou *et al.,* (2003) invented a cotton candy making machine which comprises of rotatory pot having a rotation axis,a heater is included to heat sugar to produce cotton sugar threads**.**Masatoshi *et al*., (2004) designeda machine with a removable tray. Carbon and alloy brushes are used for supplying electric current to a heater for a rotary pot. It also comprises the translucent tray and light emitting portion are provided on the main body of the apparatus for illuminating cotton candy within the tray.Huange*et al.,* (2008)invented a cotton candy making machine that also allows sugar material to be outputted in a particular shape as desired. Laskey*et al*., (1918) and Dykeman *et al*., (1920) invented a candy making machine which consist of a cylinder and a piston arrangement to deliver the candy through nozzle. Cloud *et al*.,(1983) invented a milk toffee making machine, which consists of toffee header which is connected to a heater and spaced orifice on its underside for toffee to exit strand which has rotary toffee forming device. A chocolate bath of milk chocolate is provided for first immersing the bottom of the toffee core and then for flooding chocolates over
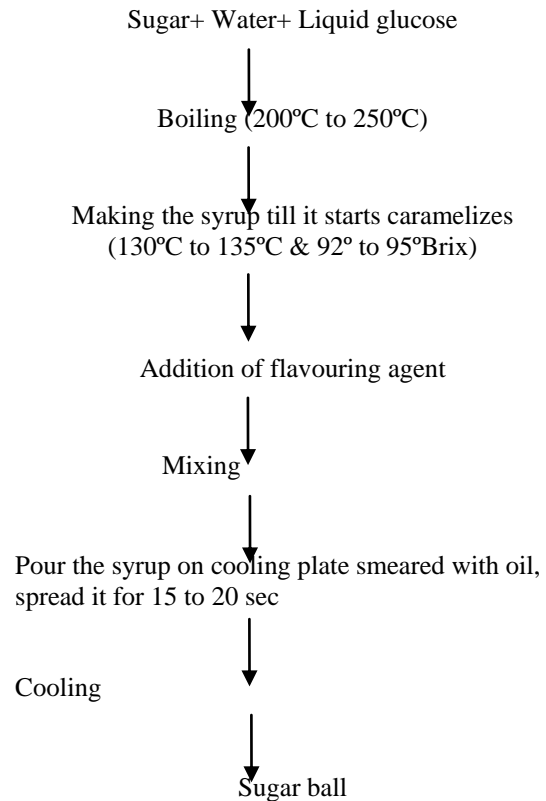
the top of the core to completely coat the core which is carried out with the help of conveyor which is attached with the cooling apparatus to lace the chocolate covered core in condition for packaging.Bausam*et al.,* (1930) invented a confection cluster making machine which comprises an intermittently movable member on which the cluster are formed and means for individually coating the pieces which are to be formed in to a cluster and means for conveying the individually coated pieces and dropping them successively upon member while their coatings are still plastic, coated piece drop upon member while it is at rest pile up one upon another adhere to form the cluster.

Karpenko*et al.,*(1967) invented a machine for making "iris" toffee type candy, which comprises of collector with a stirrer in which preheated mixture of caramel mass is fed and a heat exchanger is connected through pump with collector, a centrifugal cyclone steam separator provided with pipe for vapour evacuation, a hopper into which mixture is fed from the cyclone steam separator having a lateral slot in the bottom and a device provided with the nozzle for spraying a flavouring material on to mixture, a cooling device consisting of a cooling cylinder and a cooled inclined plate being provided with swingable vane for shaping mass in to a multilayer stick which is conveyed by the conveyor to wrapping machine.Ruffinatti*et al.,* (1974) invented a machine for drawing sugar based plastic material in which sugar is treated in the plastic state by pulling and folding it to incorporate air in to the material and to impart fibrous silky appearance. The machine comprises of a base carrying a table upward from which extends a central post and a head which projects over the table and carries two arms which are pivoted at one end and have downwardly extending pins at the other end, the arms are positioned and shaped in such a way that when they rotates about pivoted ends the pins describe circles which overlap and which encircle the upstanding post without interfering with it or each other.

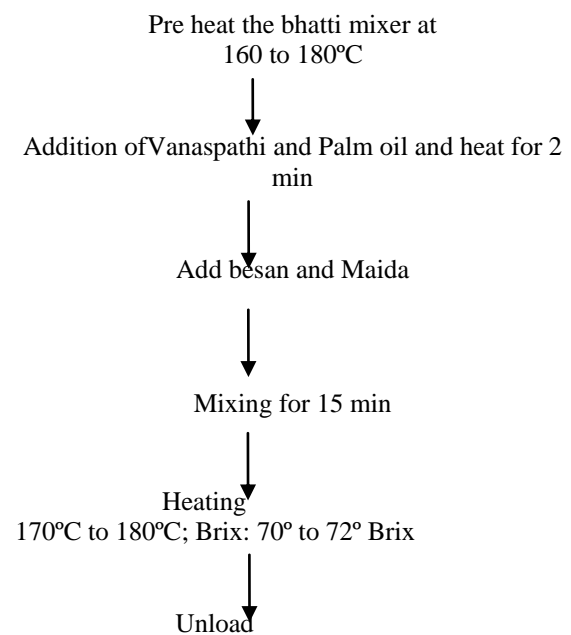## 2. Materials and methods

2.1 Preparation of Sugar Ball

The first stage in making soanpapdi involves the boiling of sugar with water along with liquid glucose in a vessel over the burner at 200ºC to 250ºC temperature until it starts caramelizes and should attained 92º to 95ºBrix. When the boiled sugar reaches 135^0 C, it should be poured out onto a tray and folded. The folding keeps the sugar flexible while incorporating air and cooling it; if the sugar is to be colored, colouring agents can be added at this point. Pulling of sugar is specially handled after boiling so that it turns into a glossy and smooth mass (As shown in the Fig.1).

Sugar+ Water+ Liquid glucose

Boiling (200ºC to 250ºC)

Making the syrup till it starts caramelizes
(130ºC to 135ºC & 92º to 95ºBrix)

Addition of flavouring agent

Mixing

Pour the syrup on cooling plate smeared with oil, spread it for 15 to 20 sec

Cooling

Sugar ball

Fig. 1 Preparation of sugar ball

2.2 Preparation of Besan Premix

Besan mix is prepared by heating vanaspathi and palm oil in bhatti mixer at flame temperature of 160 to 180ºC for 1 to 2 min followed by the addition of besan and maida with continuous stirring for 10 to 15 minutes and unloading of besan mix is done at 170ºC to 180ºC temperature and at Brix value 70º to 72º Brix. Fig.2 explains the preparation of basen premix.

Pre heat the bhatti mixer at
160 to 180ºC

Addition ofVanaspathi and Palm oil and heat for 2 min

Add besan and Maida

Mixing for 15 min

Heating
170ºC to 180ºC; Brix: 70º to 72º Brix

Unload

Fig. 2 Preparation of besan premix

2.3 Preparation of Soanpapdi

Soanpapdi is prepared by kneading the prepared sugar syrup on wooden frame to form a rope like texture by beating and twisting the sugar syrup followed by the addition of besan mix at predetermined time interval and drying of soanpapdi is done to obtain the flakes of soanpapdi(Fig.3).

Kneading the sugar syrup dough on wooden frame

↓

Make a rope like texture by beating and twisting the sugar syrup dough

↓

Addition ofbesan pre mix at predetermined time interval

↓

Addition of flavouring agent (flavour as per recipe)

Drying

↓

Spreading badam and pista slices for garnishing in stainless steel frame

↓

Cutting and packaging

Fig 3Preparation of soanpapdi

2.4 Soanpapdimachine

2.4.1 Table assembly

Rotating table is made up of stainless steel 304 grades with the composition of 18% chromium and 8% nickel, combined with a maximum of 0.08% carbon and having outer diameter of 540 mm with the thickness 10 mm which is operated by the 1hp motor situated beneath the table.

2.4.2 Arm assembly

Machine consists of four stainless steel arms. two arm fixed at the centre of rotating tablemainly hold the sugar ball at the centre to ease the pulling process having outer diameter of 16 mm and length is 172 mm and other two arms with the same diameter are projected over the rotating table which are fixed and assembled without touching the table is mainly help in pulling of sugar ball by rotating in opposite direction.

Fig.4 Soanpapdi flaking machine

2.5 Performance evaluation of machine

2.5.1 Capacity

Capacity of soanpapdi flaking machine was calculated by using following formula (Ojomo*et al.*, 2010).

$$Capacity\ (Kg/h) = \frac{Weight\ of\ the\ product}{Time}$$

2.5.2 Wastage

The product falls out from the table during preparation of soanpapdiwere collected and weigh by using electronic weighing machine which gives the wastage of product during soanpapdipreparation.

2.5.3 Threading Efficiency

The efficiency of the machine to form the soanpapdi threads was calculated by the following formula (Bandara*et al.*, 2007).

$$Threading\ efficiency = \frac{Quantity\ of\ whole\ thread\ obtained}{Total\ quantity\ of\ Feed} x100$$

2.5.4 Sample Analysis by Scanning Electron Microscope

A scanning electron microscope (SEM) is a type of electron microscope that images a sample by scanning it with a beam of electrons in a raster scanpattern. The electrons interact with the atoms that make up the sample producing signals that contain information about the sample's surface topography, composition, and other properties such as electrical conductivity. Different scaling levels of 5 to 50μm were used for the soan papdi particle size analysis.

3. Results and discussion

3.1 Consistency of sugar ball

Theconsistency ofsoft ball is having a temperature around 112°C–115°C and having 85% sugar concentration.The consistency offirm ball is having a temperature around 116°C–120°C and having 87% sugar concentration.The consistency of hard ball consistency is having a temperature

around 121–131°Cand having 92% sugar concentration.

3.2 Optimising the Machine parameters

The optimization of machine parameters such as speed of rotating table (rpm) and speed of rotating arms(rpm) on the basis of time, capacity of the machine, threading efficiency, and wastage were recorded.

3.3 Time

The time taken by the machine for producing soanpapdi was determined at different speed of rotating table at different consistency of sugar ball. There is a significant decrease in time taken by machinefor producing soanpapdi at firm ball consistency while increase in the speed of rotating table. Fig.5 depicted that there is linearity between the speed of rotating table and time taken.

The time taken by the machine for producing soanpapdi is less at firm ball consistency and at 14 rpm speed of rotating table as compared to soft and hard ball sugar consistency. This may be due to the speed of rotating table is more at 14 rpm and the moisture content of firm ball consistency is adequate which favours the pulling of sugar and hence take less time to form threads.
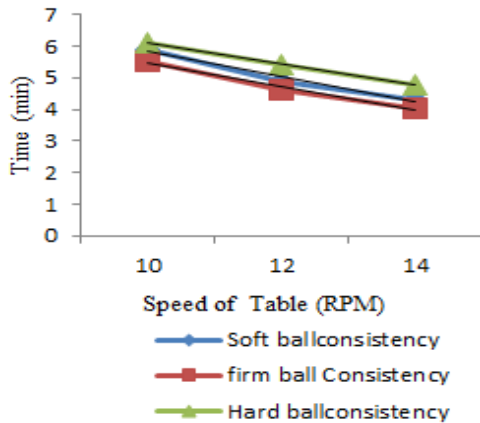

Fig. 5 Effect of speed of rotating table and consistency of sugar on time

3.4 Capacity

The capacity of the machine for producing soanpapdi was determined at different speeds ofrotating tableat different consistencies of sugar balls and their relationship is shown in Fig.6. The capacity of the machineat soft ball consistency is graduallyincreasing with increase in speed of rotating tableat 14 rpm speed of rotating table as compared to soft and hard sugar ball consistency. This is may be due to the time taken by the machine at firm ball consistency is less which results in increase in capacity.
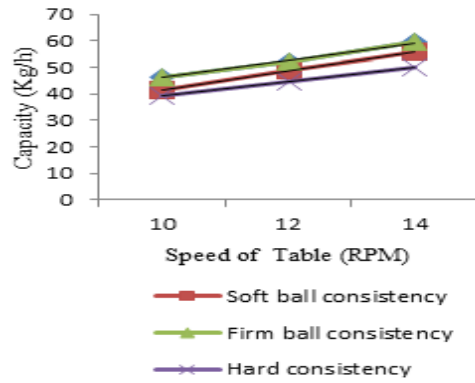

Fig. 6 Effect of speed of rotating table and consistency on capacity.

3.5 Threading Efficiency

Fig.7 explainsthreading efficiency of the machineat soft ball consistency gradually increases and then decreasesas the speed of rotating table increases.
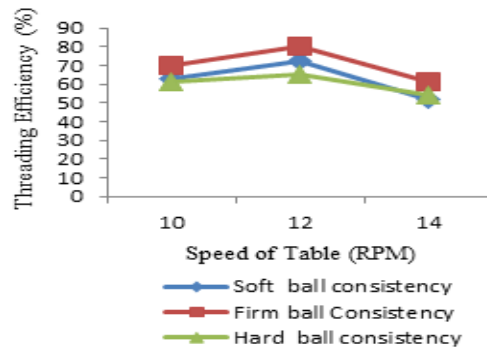

Fig. 7 Effect of speed of rotating table and consistency of sugar on threading efficiency

The threading efficiency of the machine for producing soanpapdi is more at firm ball consistency and at 12 rpm speed of rotating table as compared to soft and hard sugar ball consistency. This may be due to the optimum amount of moisture content in firm ball consistency as compare to soft and hard ball consistency which ease the pulling operation and 10 rpm speed of rotating table take more time which results in hardness of sugar soon which indirectly effect the sugar pulling operation and hence threading efficiency is less and 14 rpm speed of rotating table results in breaking of thread due to its high speed of rotation and hence effect the threading efficiency.

3.6 Wastage

The wastage of product during preparation of soanpapdi at soft ball consistency increases from 1.7 to 2.1 % and peaks up to 2.8 % as the speed of rotating table increases. The wastage of product during preparation of soanpapdi is more at soft ball

consistency and at 14 rpm speed of rotating table as compared to firm and hard sugar ball consistency. This may be due to the high rpm of table gives more force to the product which ultimately leads to the fallout of the product from the table.

3.7 SEM (Scanning electron Microscopy) analysis

The morphological characteristics of commercially available soanpapdi sample were analyzed by scanning electron microscope shown in the Fig.8.The result shows that, the particle shape is perfect oval than usual flaky nature of soanpapdi. This was mainly due to the addition of besan and the maida during the preparation.The microscopic view of the sample in different scaling varying from 5µm to 50 µm clearly indicates free flowing, less clumpy nature of the product and thereby assures a good quality for the food product. Results were supported by the SEM analysis of free flowing milk powders obtained by spray drying (SengodanGurusamy and Mishra, 2006). The moisture content and dispersion of particles is very important criteria for the perfect physical nature of the product. Thus, based on SEM results the product showed good physical appearance in microscopic view. The morphological characteristics of optimized soanpapdi sample were analyzed by scanning electron microscope shown in the Fig. 9.The result shows that, the particle shape of soanpapdi is not perfectly oval and particles are compact to each other. This may be due to presence of sugar particles and thick threads of soanpapdi.The microscopic view of the sample in different scaling varying from 10µm to 50 µm clearly indicates that the product has homogeneous compact structure and has fewer pores. Thus based on SEM results the product showed compact physical appearance in microscopic view. It is concluded from Fig. 8 and 9 that the optimized soanpapdi sample which was prepared at firm consistency of sugar syrup and at 14 rpm speed of rotating table has some amount of sugar in it which is not converted to thin flakes as compared to the commercially available sample.
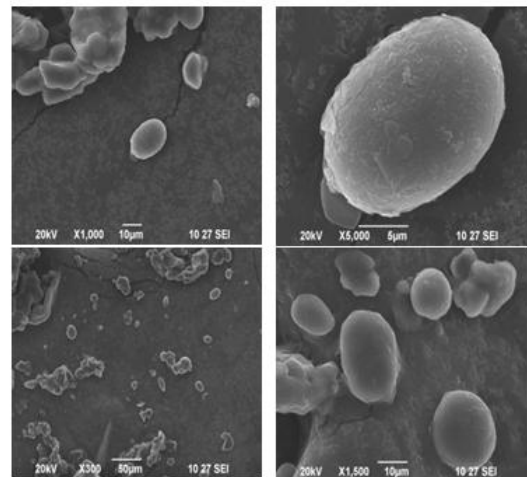
Fig. 8 Scanning electron microscopic view of commercially available soanpapdi at different scaling levels.
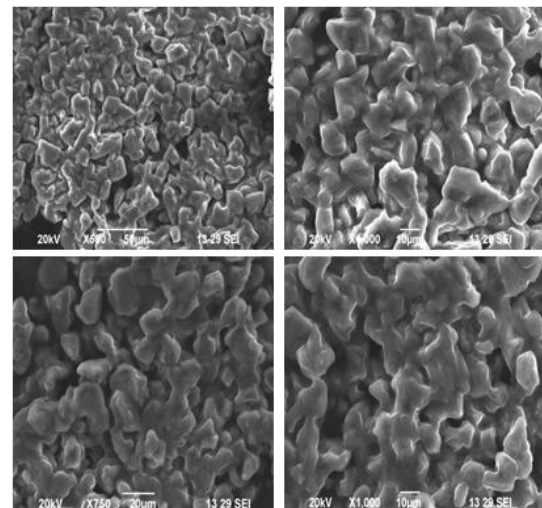
Fig. 12 Scanning electron microscopic view of Optimized Soanpapdi at different scaling levels.

Conclusion

Soanpapdi flaking machine consist of rotating table and arm was developed and performance of soanpapdi flaking machine is evaluated.The behaviour of sugar ball of various consistencies was recorded in terms of time, capacity, threading efficiency and wastage. The firm consistency was found to be best in terms all parameters.The time taken by the machine for the production of soanpapdi is 4.03 min at 14 rpm speed of rotating table and also showed optimum capacity of 40 kg/h. The maximum threading efficiency of 80% is recorded at 14 rpm of rotating table. The wastage of product during preparation is found around 1.5%. SEM analysis indicated that the optimized sample particles are compact to each other and not perfectly oval in shape.

REFERENCES

[1] Bandara, D., B.Bandara, W. Wickramanayaka, H. Rathnayake, D.Senanayake and K. Palipane.2007.Design and Development of A Small /Medium Scale Rice Flaking Machinery for Manufacture of Rice Flakes.*Annual Transactions of IESL*.168-175,

[2] Bandou, T., and H.Koichiro.2003.*Cotton candy making machine*.US Patent.6612823B2.

[3] Bausam, A.L.1930.*Confection making machine*. US Patent.1,761,065.

[4] Cloud A Davida, Charles E. Cloud.1983. *Candy Makking Machine*.US Patent.4,385,882.

[5] Dykeman, L.E (1920) *candy making machine*. US Patent.1343120.

[6] Huange Yuh-Hwai.2008. *Cotton candy making machine*. US patent. 0031987A1.AA.

[7] John.T Sullivan *et al*., (1988). Cotton candy machine. US 4793782 A

[8] Karpenko, A.K , V.B Bondareva and M.D Malinin.1967.Method and Apparatus for making milk caramel mass from manufacturing "IRIS".US Patent.US 3,356,045.

[9] Laskey.1918. *candy making machine*. US Patent.1281592.

[10] Masatoshi todokaro.,Matsudo.2004.*Cotton candy making apparatus*.US Patent.6,722,869 B2.

[11] Ojomo, A.O., L.A Agbetoye,S.Ologunagba.2010.Performance Evaluation Of Fish Feed Pelletizing Machine.*ARPN Journal of Engineering and Applied Sciences*. 5: 1819-6608.

[12] Ruffinatti,G.,Giaveno.1974.*Machine for drawing sugar based plastic material*.US Patent.3825234.

[13] Sengodanguruswamy, V., and Mishra, D.N., 2006. Preparation and evaluation of solid dispersion of meloxicam with skimmed milk. The Pharmaceutic. Soc. Jap., 126(2): 93-97.

[14] Tsumita Mitsuyo,Mavcndotton cmita and Yuji Yamane.1989.*Cotton candy machine*.US Patent. 4842502.

[15] Vanhonacker F, Verbeke W, Lengard V et al.(2008) Consumer-based definition and general image of traditional foods in Europe. In: Perspectives of Traditional Food Supply Chains on the European Market, Proceedings of 12th Congress of the European Association of Agricultural Economists People, Food and Environments: Global Trends and European Strategies', 26-29 August 2008, Ghent, Belgium.

[16] Warning.1975. *Method for Making Cotton Candy*. United States Patent.3,930,043.

[17] Yamamoto,I., Akio Iida and Kaoru Kikuchi.1989.*Apparatus for making cotton candy*. US Patent.4,846,643.