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Environmental Management of Petha Industry in Agra City

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Abstract: **Petha, the "delicacy" from the Taj Mahal city of Agra, traces its history back to almost 4 centuries, when it served as an instant source of energy to thousands of workers involved in the making of the great monument, Taj Mahal. Prepared by boiling and processing Ash Gourd (the vegetable "petha"), this sweet is the livelihood of thousands of workers in Agra. About 1500 cottage units produce 700-800 tonnes of Petha daily, while consuming 225 tonnes of coal or firewood every day. The organic solid waste and the emissions from coal combustion have been implicated in environmental problems in the Agra city and the adjoining stretch of river Yamuna. Although the use of coal was banned by the Supreme Court in 1996, it had not been implemented till very recently. Agra has also been declared as a part of the Taj Trapezium Zone (TTZ). Petha industry in TTZ has recently been ordered to either switch to gas-based technology or move their units, with the new proposed site being Petha Nagri in Kalindi Puram from the existing Noori Darwaza area. A USAID-CIT project has shown potential methanation of the solid waste from petha industry and successfully demonstrated the production of 25-30 m^3 of biogas per tonne of waste disposed. Plans were also underfoot to construct a 35 tpd waste-to-energy plant, however were never implemented. This work discusses the potential solutions to this environmental-social-economic-technical dilemma, while giving a brief background of petha manufacturing process, legal guidelines & rulings and environmental threat of process effluents. This article aims to provide sufficient information to all the stakeholders so that informed decisions on sustainable petha manufacturing can be taken.**

Keywords: **Petha, waste, environment, Agra**

1. INTRODUCTION

The city of Agra derives its fame from two world famous symbols: Taj Mahal and Petha. No visit to this North Indian city is complete without either of them. Agra's petha is so famous that even though other varieties are available in most of the Indian markets, the Agra variant is the most sought after. Petha, in essence, is processed and sweetened form of the vegetable "Ash Gourd" or "white pumpkin", more commonly known as "petha". Today, almost 1500 cottage industries in Agra city (mostly concentrated in Noori Darwaza area) produce almost 700-800 tonnes.

1.1 History of "Petha"

The exact origins of petha are not known, although its history has been linked to the Mughal Empire. During the time of Mughal Emperor Jahangir, around 16th century, Agra was the capital of Mughal Empire. It is believed that Queen NurJahan, tasted the petha at the petha market (which was later named Noori Darwaza in her honor and serves as the current location of petha market) and, enamored by this delicacy, decided to take it to the royal kitchen. It is also said that petha served as an instant energy food source to thousands of workers involved in the making of the 17th century Taj Mahal. The first form of petha is believed to be "Gulabi (or rose)" and is suspected to be over a thousand year old. The patronage of Queen NurJahan led to the crystalline and translucent form of petha that is considered by many to be the original form these days. Over last few centuries, esp. in the last couple of decades, several varieties and flavors of petha have been developed, including paan, chocolate, kesar, angoori, mango, coconut, etc., to make a few.

2. MEDICAL BENEFITS AND NUTRITIONAL VALUES OF PETHA

The vegetable "petha" or ash gourd is highly enriched with calcium, minerals & carbohydrates [1]. All Petha products are highly recommended for growing children, lactating mother, during jaundice due to richness in glucose and minerals. It helps in nourishing the brain and enhancing nervous system. The Petha preparation does not involve the use of fat cooking oils, so it has negligible fat content and is free from cholesterol. Wholesome and nutritive, it is known to act like a blood coagulant and is used in treatment of peptic ulcers and obesity. The delicious sweet preparations made from it are used for the treatment of tuberculosis, weakness of the heart and anemia. Although high in sugar content, this nourishing sweet has a multitude of nutritional and medical benefits and is a cheap source of instant energy for people [2], while also protecting them from high summer temperatures due to its cooling properties.

3. MANUFACTURING PROCESS OF PETHA

Petha manufacturing is a cottage industry and almost 1500 such units are involved in its production in the city of Agra, with a daily estimated capacity of 700-800 tonnes of petha sweet. The various steps involved in the traditional manufacturing of petha are illustrated in figures 1 and 2. The two main raw materials used for processing of petha fruit are

the raw fruit and sugar. Interestingly, the petha fruit is not native to Agra and is supplied from various parts of Uttar Pradesh (Etah, Etawah, Aligarh, Meerut, etc.), Maharashtra, Madhya Pradesh, Banglore, Pune, etc. The other raw material, sugar, is generally supplied from Daurala and Rampur in Uttar Pradesh and from Maharashtra. Since the petha sweet is perishable, it is dried and packed in boxes. However, due to its increasing demand in other countries, manufacturers have started the "canning" of petha sweet without drying it, thus making the export to far away regions possible [3].

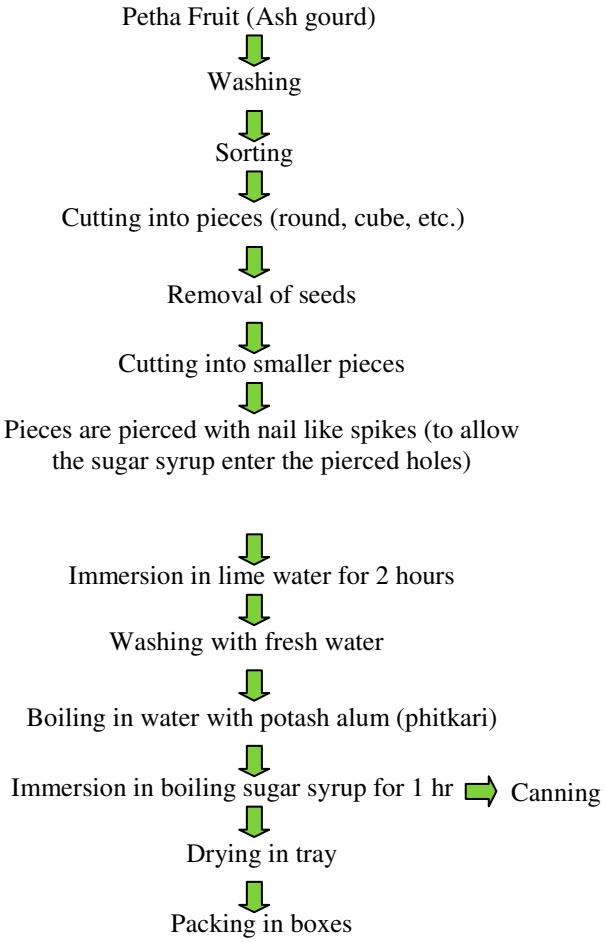

Figure 1. Chronological sequence of Petha manufacturing

(a) **(b)**

(c) **(d)**

(e) **(f)**

Figure 2. Key steps in manufacturing process of petha: (a) Petha fruit, (b) sorting, (c) cutting into small pieces, (d) removal of seeds, (e) piercing by spikes, (f) immersion in sugar syrup and (g) final petha sweet.

4. ENVIRONMENTAL THREAT

In spite of the immense popularity and historical significance of this sweet, petha is also a prominent threat to the environment of the Agra city and cities downstream from it. And this potent threat affects all three: water, air and land.

4.1 Land Pollution through solid waste

Petha industry generates a significant amount of solid waste, which is organic in nature [4]. This solid waste chiefly consists of the fruit peel and the seed. Only about 40% of the petha fruit is used in the preparation of this sweet, leaving the

rest 60% as solid waste to be disposed off by the city [5]. Most of this waste finds its way to open dumps and after putrefaction, leads to foul smell, unpleasant sight and serves as a source of nuisance.

4.2 Water Pollution through discharge of processing water

It is estimated that each of these 1500 cottage units use about 50kg of limestone daily [6], which is discharged to the drains. This chemical is used to make lime water which helps in tightening of the petha fruit. Discharge of lime water to the drains leads to sewer clogging. Apart from the lime water, other sources of wastewater from petha industry include water used in washing, sugar syrup, water containing alum, etc. This process wastewater is high in biochemical oxygen demand (BOD) and chemical oxygen demand (COD) and has low dissolved oxygen (DO) levels.

4.3 Air pollution through use of coal

The main source of air pollution from petha industry is the use of about 225 tonnes of coal or firewood everyday [6]. This leads to generation of various gases which coupled with morning fog causes smog-like conditions [6]. The solid leftover wastes such as fly ash and particulate matter are another nuisance.

5. LEGISLATIVE ACTIONS

In 1996, the Supreme Court of India banned the use of coal and had directed concerned authorities to ensure minimum pollution and shifting of coal-based industries (including Petha) to the city outskirts. However, no steps were taken by the administration for its implementation.

In 1999, Taj Trapezium Zone (TTZ) Authority was announced covering an area of 10, 400 km^2 to protect Taj Mahal.

In 2002, the Government ordered the petha industry to either switch to a cleaner fuel such as LPG (Liquified Petroleum Gas) or CNG (Compressed natural gas) to reduce the pollution due to coal [6]. This order failed to have any effect on the petha industry and the same traditional practice continued.

In 2003, the industries within the TTZ were ordered to either switch to gas-based technology or move their units. The state government also developed a “Petha nagri” in Kalindi Puram and the land was allotted to the maufacturers. However, neither the manufacturers stopped using coal nor they shifted to the new Petha Nagri [6].

In 2013, after a lot of pressure, the Agra Administration and the Uttar Pradesh Pollution Control Board (UPPCB) banned the entry of coal trucks into city and very recently have sealed units still using coal [6]. The petha manufacturers are now forced either switch to low pollution preparation or shift to a new location.

So a after a span of almost 18 years, the ruling of the Supreme Court is finally being implemented leading to either a change in traditional petha preparation or displacement from the existing locality. This has also lead to the migration of many petha workers to other states. However, the local petha manufacturers claim that the taste of Agra petha could not be duplicated as the Yamuna water played an important role in imparting this particular taste to the sweet and efforts to replicate this taste had failed elsewhere due to a difference in the water source.

An interesting point to note is the lack of any governmental regulations regarding the disposal of solid waste or process wastewater.

6. POTENTIAL TREATMENT OPTIONS: BIOGAS GENERATION THROUGH METHANATION OF ORGANIC SOLID WASTE

Clean Technology Initiative (CTI) Project - a program of U S Agency for International Development (USAID) was launched in May 2003 for the Taz Trapezium Zone (TTZ) to assist the industries and urban sectors to minimize pollution which affects the great monument Taj Mahal [7]. CTI offers technical and financial assistance to identified polluting industrial sectors to adopt clean, climate friendly technologies and certifiable environmental management systems (ISO 14001). CTI aims to promote demonstration projects with improved technical and environmental performance and helped industries facing closure due to changeover of fuel source from highly polluting coal to clean natural gas at the instruction of the Honb’le Supreme Court of India. In an effort to help the city of Agra with integrated solid waste management (including waste collection, segregation and disposal), CTI installed a “waste-to-energy” demonstration plant. Installed in partnership with a private company, Mailhem Engineering, this demonstration plant disposes off the organic solid waste obtained from Petha industry and generates biogas. [8]

The CTI-Mailhem Engineering biomethanation plant uses the petha waste as the raw material and converts it to biogas. The plant has successfully demonstrated a generation of 25-30 m^3 biogas per tonne of petha waste processed. This product gas is successfully used in the preparation of petha and namkeen. Additionally, the residue of this plant is an excellent organic fertilizer. Based on this successful “waste-to-energy” demonstration, plans were initiated to construct a 35 ton/day biomethanation plant to sustainably dispose off the petha waste generated by about 200 units located within the heart of the city [8]. These units are difficult to remove due to social, economic and political compulsions. The proposed site for the project was the Sabji Mandi Sikandra area. However, this

project was not further developed due to lack of awareness, interest and funding from local petha owners and the government.

In recent years, researchers have come up with other innovative applications of petha waste. *Spirulina platensis*, a cyanobacterium rich in protein and vitamin B_{12}, has been shown to grow using petha waste as food source. Spirulina prevents and inhibits cancer, decreases blood cholesterol levels, stimulates immunological system, reduces the nefrotoxicity of pharmaceuticals & toxic metals and also protects against harmful radiation [9]. It has been shown recently that biohydrogen production from petha waste can be significantly increased by pretreatment of the microbial consortia [10].

7. ENVIRONMENTAL MANAGEMENT OF PETHA WASTE: A DILEMMA

The environmental management of petha waste in Agra city is nothing short of a environmental-social-economic-technical-political dilemma. The petha industry employs thousands of people through 1500 small and medium cottage industries. It consumes more than 300 trucks of petha fruit and 225 tonnes of coal daily, producing 700-800 tonnes of petha sweet. The industry is worth over Rs. 600 crores annually 11]. It's not only the size of the industry but the cultural heritage as well that makes petha a significant issue. Many people, including manufacturers, attribute the taste of petha to the traditional preparation that uses coal and also the water of river Yamnua [11]. If shifted to some other location or by using gas-based manufacturing, it is claimed that petha will not taste the same. The industry provides year-round employment to thousands of people and hence its relocation or closure will lead to migration of this work-force. In addition, legislative issues still ensue. As mentioned earlier, it took almost 18 years after the ruling of the Supreme Court for the authorities to seal coal-consuming petha industries [11]. Interestingly, the original ruling and the subsequent actions/legislations are only useful for prevention of air pollution due to coal (and also some solid waste issues due to fly ash). However, these do not account for the solid waste generated from this industry, which as already mentioned is composed of almost 60% of the fruit used. And no legislation is in place to prevent the disposal of lime water and other process wastewater to the river Yamuna. On top of it all, the technical solutions have not yet been implemented due to various factors including (but not limited to) the need for further research, funds and awareness. In conclusion, a concerted effort from all the stakeholders, including the manufacturers, government and the people is needed to come up with a sustainable plan for efficient management of this dilemma.

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