RESEARCH ARTICLE

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Effects of Particles Size on Tea Processing: A Perspective on Zobo Production

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ABSTRACT

This report presents a comprehensive review of effects of tea particle size (*PS*), dipping temperature, infusion time, dipping frequency and effect of permeance on tea infusion focusing on zobo (Roselle – *Hibiscus sabdariffa*) tea. Tea production process follows a series of unit operations depending on the type of tea being produced. Various forms of tea are scented, white, oolong, green and black teas. Generally, the basic unit operation involves include withering, maceration, fermentation, fixation, rolling or shaping, drying, and curing or aging of the tea leaves. Before drinking, the processed tea is prepared by infusing the tea leaves in hot or cold water with or without tea bags. For maximum extraction of bioactive compounds which are responsible for the high nutritive and functional properties of tea, it is important to understand tea infusion process and factors affecting the infusion kinetics (*IK*). *PS* and distribution of food powders, their measurements and their instrumentations are displayed as well as the undesirable phenomena in food powders. Tea packages and tea bag selections, effect of different factors in tea *IK*, novel technology for tea production and future prospect of tea production are also discussed. This review aims at providing information for the understanding of tea *PS* and factors affecting tea *IK* thereby enhancing the understanding of different principles behind tea infusion; a perspective on zobo production.

Keywords: Particle size, Tea infusion, Tea production, Zobo.

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I. INTRODUCTION

Apart from water consumption, tea beverage is amongst the ultimate commonly consumed globally. Tea manufacturing process follows different steps such as withering, maceration, fermentation, fixation, rolling or shaping, drying, curing or aging and grading, depending on the type of tea and part of the world where the tea is produced [1]. Tea is prepared for drinking via tea leaves infusion in cold or boiled water with or without a tea bag, the preparation techniques such as; the ratio of tea leaf to water, infusion interval, the degree of hotness or coldness of extraction/infusion and the degree of agitation employed are very significant due to the fact that the nutritional and medicinal qualities of the tea beverage is a function of the biochemical constituents gotten from the leaf in the course of brewing. Some bioactive complexes like caffeine and polyphenols possess some properties that are actually responsible for the refreshment and soothing condition of tea. The extraction efficiency of these bioactive complexes is a function of how efficient the tea is brewed. Similarly, due to solubility of these complexes in water, they are mostly brewed in hot conditions [2].

The quality of tea is a function of numerous factors as influenced by tea infusion kinetics (*IK*) such as brewing temperature variation, disparities in tea brands and their particle sizes (*PS*). Findings showed that tea infusion profile is enhanced when the temperature of brewing is heightened, and *PS* of the tea reduced as tea with very fine particle fractions had the maximum infusion profile [3]. This may be as a result of increasing the tea particle surface area as the *PS* is reduced. These observations were also reported previously [4]. Hence, powder *PS* of tea plays an important role in tea production process. Zobo is from Roselle plant (*Hibiscus sabdariffa*), an annual perennial herb or woody based subshrub naturally found in West Africa, East Africa and South-East Asia. Zobo is rich in phenols and flavonoids which make it a good source of antioxidant, antihypertensive and anti-inflammatory drink [5]–[8]. The purpose of this review study was to understand the effects of powder *PS* in tea production process with the focus on zobo tea production.

II. Tea Processing Dynamics

Various forms of tea exist in varying sensory and organoleptic properties owing to slight modifications in their processing steps (see Figure 1). Tea products can be generally categorized into conventional teas such as completely fermented black tea, partially fermented Oolong (red and yellow) tea and unfermented green tea and nonconventional tea products such as cold- and hot-soluble instant tea, flavored tea and decaffeinated tea [9]. Tea beverages, bottled teas, canned teas, soluble tea mixes, frozen tea liquid, and tea tablets are considered as convenience tea products. Fresh products like liquid tea concentrates, teas and iced tea mixes, as well as fruit tea mixes offers remarkable increase in the global market.

Conventional Teas are processed by harvesting or plucking of the tea leaves, withering for initial removal of moisture content, breaking up by rolling the withered tea leaves followed by crushing, Tearing and Curling, fermentation, drying or frying, grading and storage of fermented tea.

Non-conventional Tea Products which include instant tea, flavoured tea and Decaffeinated tea are prepare using different methods and according to the consumer's specification. Dehydration of infused black or green tea may result in a very hygroscopic product known as Instant tea. Instant teas exist in various varieties such as hot soluble instant tea and cold-soluble instant tea being a function of consumer choices. Raw materials for the preparation of Instant tea include black tea, green tea etc. Low-quality tea, crude tea leaves and dust tea waste could also serve as instant tea raw material besides processed tea. Component materials quality control is compulsory in achieving a good quality Instant tea. Flavoured teas can be gotten by combination of numerous natural or nature-identical flavors in processed teas (black tea, green tea, Oolong tea, instant tea, decaffeinated black tea, and decaffeinated instant tea). Natural flowers or petals or skin peels of citrus fruits can be integrated after the frying step during tea production. Spices such as ginger, cardamon, clove, cinnamon can be incorporated to make spiced tea while lemon, orange, mint, bergamot, and rose can be added to produce scented teas. Extracts from fruits can also be integrated to offer their fruity taste to tea.

Tea that has been decaffeinated are produced to cater for the health concern of consumers who are affected by caffeine intake. Solvent extraction process is used to separate some great percentage of caffeine from the black tea through decaffeination.

III. *PS* of Tea

PS analysis is involved with the means of measuring solid, liquid, or gaseous particles and relating its understanding with operational design of several processes comprising dry particles and powders [11]-[12]. *PS* has influence on the storage and flowability condition of a powder. Flowability can be said to be the proportion between cohesive forces that act on particles (that enhance their stickiness) and the normal forces (that try to keep them apart), [13]. Powder characterization depends on the individual characteristic of a particle as an entity, the particles assembly characteristics, and the interactions between assembled particles and the fluid in which the particles are infused. Teas are processed into powdered particle to enhance tea infusion process. The quality evaluation of the characteristics of suspensions and powdery materials are carried out using properties like size, shape, density, fluid properties such as viscosity, dispersion and concentration state, particles velocity and material powders rehydration rate etc. These properties are very essential to products behavioral properties with *PS* being the most essential property. "Size" is frequently used as a measure of powder assessment depending on fineness or coarseness of the particle.

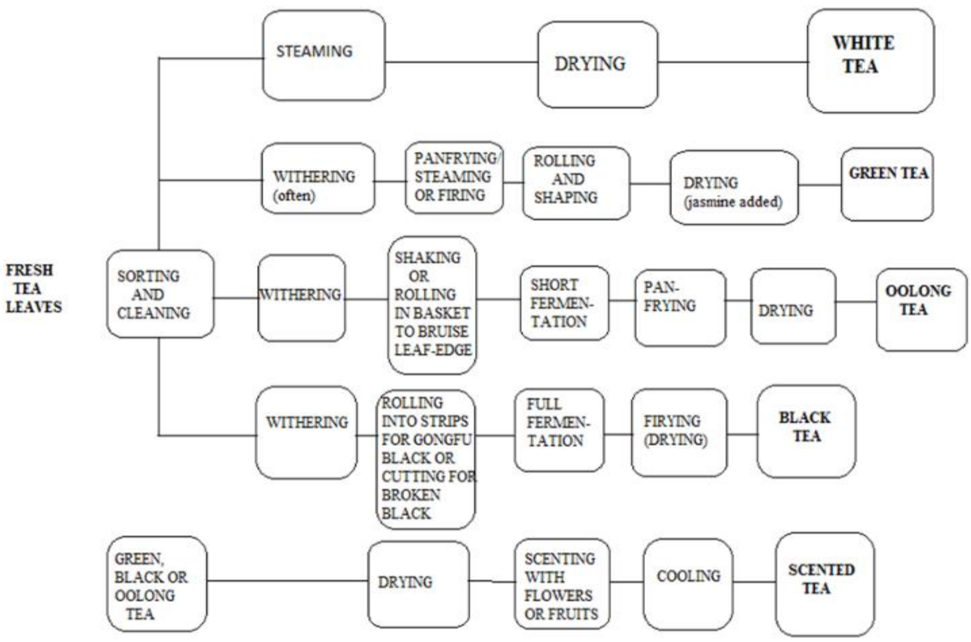

Fig. 1. Flowchart for tea processing. Source: Anonymous (2021) [10].

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A. Particle Size Distribution (PSD)

Adequate knowledge about the distribution of *PS* of powders is important in chemical processes because, wrong analyses in *PS* may lead to reduced quality products and high rates of rejection, resulting in economic losses. Particle-size distribution of dry powders or fluid particles are sets of standards expressed mathematically in order to describe the comparative amount, characteristically by mass, of existing particles with respect to size [14], [15]. *PS* and its distribution can have a high influence on the physical, sensory, mechanical, electrical, thermal and chemical characteristics of the finished product [14], [16]–[17]. Most foods are often presented in the form of fine particles in the course of processing, handling and marketing. Hence, for physical, textural, mechanical, or chemical processes involve in food production; measurement of *PSD* is commonly used due to its direct relationship to behavior of the material and/or physical properties of the products [18]. Particulate sizes and its distribution also influence the compressibility, bulk density, and flowability of a food powder [18]. Segregation which is also an industrial problem may occur in a powdery material mixture due to variation in *PS* [18]. Diverse categories of instruments are available to measure *PSD* and they may be categorized into five broad techniques: sieving, stream scanning, sedimentation, microscopy techniques, and on-line measurement techniques. Selections of any of these techniques depend on the category of the *PS* and the way size occur. For a particular powder material to be quantified or evaluated, four (4) particulate size quantities are to be assessed such as number, length, surface, or mass (or volume).

B. Techniques for Particulate Size Evaluation

1) Sieving

Sieving is a method of *PS* analysis that uses the principle of geometry similarity. It gives a *PSD* according to mass of particles on each sieve size range. Sieve aperture can aid the *PS* to be defined as particle pass through or retain in the mesh. A good quality standard sieve series (see Fig. 2) generally comprises of a set of good quality standard sieves with standard apertures covering ranging from microns (μm) to centimeters (*cm*). The size measurement of the sieve is the least aperture square that particles can go through. Sieve size is determined by the size of the mesh, being the number of mesh wires of each linear inch. The sieves aperture size is determined by mesh size and wire diameter. The ratio of mesh aperture of a specified sieve to the mesh aperture of the subsequent sieve in a sieve series is constant.

Sieving analysis is done by way of assembling the individual sieves in mounting or ascending order of mesh aperture size, then introducing the powdered materials on the uppermost sieve, and then making or ensuring the vibration and gyration of the sieves by the use of machine or with the help of human hand for a specified time, then realizing or determining the fractional weight of the materials retained on respective sieve [18]. Some supplementary forces could likewise be utilized to aid the sieving process, like vibrating air column, air jet as well as liquid flow.

Fig. 2. Sieve. Source: [19].

2) Microscopy

These techniques are the best direct techniques to evaluate *PS*, here the *PS* of materials are evaluated by the use of an optical or electron microscope. Optical microscopy is often employed to carry out direct counting, whereas electron microscopy is frequently utilized to evaluate the morphology and shapes of material particles owing to its resolution and the range it can cover [18]. Counting of material particles using a microscope is somewhat difficult, with the practical limit being at the ranges of 50 μm to 150 μm. Microscopy counting technique involve sample preparation by means of suspending the particulate materials in fluid-like media (usually with the addition of some dispersant) then placing them on slide for evaluation.

We also have techniques which involve electron microscopy such as transmission electron microscopy (*TEM*) and scanning electron microscopy (SEM). In *TEM* (see Fig. 3), material particles are being placed on a thin film that is having the support of metal grids that can actually allow the passage of electron beam. *SEM* (see Fig. 4) involve backscatter measurements where a powdery material is comprehensively mixed together with metallic substrate and the mixture is prepared to be conductive via glazing using a skinny film of carbon which comes thru a vacuum evaporator. Afterwards, the sample is set for measurement of *PS*.

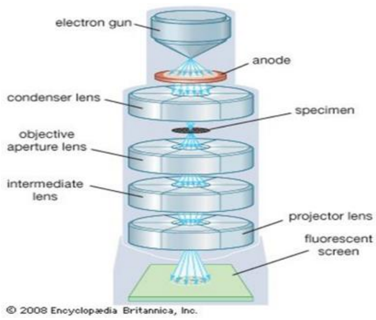

Fig. 3. Transmission electron microscope. Source: [20].

Fig. 4. Scanning electron microscope. Source: [21].

3) Sedimentation

Sedimentation measures the Stokes diameter of material particle and, hence, evaluates variables that is often required to characterize the way the particles behave in suspension [18]. Certain limitations exist regarding particulate shapes during sedimentation study due to the facts that particles which diverge completely from spheres will never fall in a vertical form, making the result to have a tendency of showing oversize material in comparison with other techniques. Generally, two factors can be responsible for erroneous dispersion evaluations. The leading factor remains incorrect sampling, as evaluations are done with a few grams of samples on behalf of the bulk samples for the evaluations to be significant. The additional factor has to do with dispersion, which is very fundamental to achieve accurate results. There are two very frequent means of *PS* evaluations via sedimentation, and these are gravimetric means and centrifugal means.

a) Gravimetric sedimentation

Gravity sedimentation is usually done using the "Andreasen" pipette technique, where a suspension of about 0.1% by volume of particles is positioned in a measuring cylinder, and a pipette is used to extract 10 ml from a fixed depth below the surface of the suspension. The concentration of the samples is then evaluated and related with the original concentration of the suspension. Due to the fact that all the particles will eventually settle at their terminal velocities, the ratio of the two concentrations is now the fractional weight of particles to have reached a depth of H cm.

b) Centrifugal sedimentation

Centrifugal sedimentation is usually employed to spread the applicability range with regards to sedimentation to sub-micron sizes. Besides, some sedimentation devices encounter effects of diffusion, convection, and Brownian motion. Increasing the speed of the settling course by centrifugation of the suspension may ease the effects. Particulate velocities do not depend only on *PS*, like in gravitational sedimentation, but they also depend on particles radial area. Some equations of analyses are being derived from the relationship between the concentration at the starting radius being initial concentration of the suspension and the concentration at the measurement zone. Centrifugal sedimentation can be done using a pipette centrifuge which is being made up of a bowl centrifuge equipped with a withdrawal device connected to a pipette. The principle of *PS* estimation is similar to that of Andreasen pipette (see Fig. 5), excepting that the particle is being subjected to centrifugal acceleration, in place of gravity force, hence ensuring the detection of particles well beneath the sub-micron range at reasonably short periods of time.

4) Stream scanning

Stream scanning procedures comprise a range of various unique methods to measure *PS*. For example, during stream scanning of a liquid or gas, in which particles are suspended, the medium can either be subjected to a specific restriction or exposed to various sources of light, which gives a reaction which is dependent on the number and concentration of particles existing in the suspension that is to be analyzed. Stream scanning method ensures that material particulates are evaluated one by one and the means by which they interact with an external field is used as a means of evaluating their sizes. Stream scanning methods employ diverse philosophies such as:

a) Laser beam diffraction caused by the particle;
b) Electrical resistance as the particles passes through a field (Coulter counter);
c) Amount of particle cut off as a particle passes through a beam;
d) Signal created from rotating scanning beam through a particle;
e) Time of flight between two laser beams; and
f) Interference pattern as a particle passes through the intersection of two laser beams (Doppler effects).

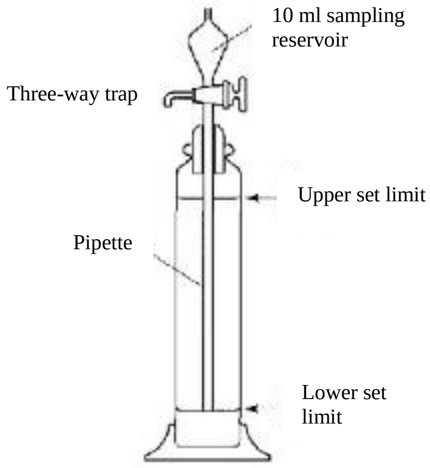

Fig. 5. Schematic representation of Andreasen pipette. Source: [22].

Laser diffraction being the commonest utilized method for *PS* analysis involve instruments that are fast, user friendly, reproducible and pretty in their ability to analyze an array of dispersion media like liquids or air streams.

5) On-line Evaluation

Process automation control has given rise to constant monitoring of *PS* of material particulates in process streams. Several on-line *PS* analyses equipment have been established in recent times to ensure this constant monitoring. It has the ability to start, regulate or halt signals in the control systems. The rudimentary conditions required for this online measurement equipment for them to function constantly and automatically at stipulated commands and the time response thru observations towards display must of necessity be prompt and instant. This somewhat innovative array of methodologies must have to be in-line with the broad configuration established within the whole subject of *PS* evaluation. Some of these evaluations involve mean diameter (central tendency), whereas other evaluation techniques may offer some more points on the size distribution. The process may involve an on-line in operations in order to evaluate the whole process stream, or it may involve the usage of a portion of the sample stream being part of the main one, or it may also involve automated rapid response batch techniques.

C. Material Particle Processing with Undesirable Effects

Attrition, segregation, caking and dust explosion have negative connotations in the production and logistics fields of food powders:

a) Attrition

Attrition means an undesirable particulate breakdown by way of fragmentation or abrasion, that raises the particulate numbers and decreases *PS*. With the exception of *PS* reduction during grinding processes, attrition is not required in many processes. Attrition can as well lead to the dust production or material losses in the entire system which may result in high remedial measures, like plant shut-down, may be necessary for filtering hazardous dusty material formed in the course of this whole process.

b) Segregation

Segregation generally means particulate material separation of abrasive material from material cluster in a powdery structural system or mechanical vibrations through application of motion (either horizontal or vertical) in a powder bed. It may also be described as a phenomenon in which material particulates of diverse properties are distributed preferentially in various segments of the powder bed, this phenomenon is simply termed as de-mixing [18]. In an enclosed structural system, segregation is frequently performed by the migration of fine particles to the bottom of powder bed while larger particles float and concentrate at the top of a powder bed.

Once there are variations in *PS,* particle shapes or density of free-flowing powders, segregation is bound to occur in that system. Segregation mostly also take place at the present of electrostatic charging on the equipment even as the powder is in motion. Segregation may result in changes in the material's appearance, texture, and flowability which may lead to complications in production, safety hazards and a total plant shutdown [18]. The commonest challenge of segregation is de-mixing, which is particle resistance to mixer actions by segregation. Even when achieving an appropriate mix, the homogeneousness of the mix will still slightly vary in successive handling processes.

c) Caking

Caking is most often an undesirable occurrence whereby amorphous food powders are changed into a sticky unwanted mass of particulate material, leading to loss of quality and functionality [18]. A powder mass can also be said to be a cake "a situation where by certain macro-particles, each capable of independent translational modes, contact and interact to form an assemblage where the particles are incapable of independent translations" [18]. This assemblage is mainly formed as a result of compositional and physical state changes. Caking can result in different composites, ranging from small, soft aggregates that can be broken easily to rock-hard lumps that need a sledge hammer to disperse. Even when caking is commonly an undesirable process, it can be desirable in the following processes like; tableting which is a compaction process, agglomeration, sintering of which particle cohesion has a positive functional role.

Caking is as a result of numerous inter-particulate forces that result from raised temperature, moisture absorption, or static pressure in the course of processing, transportation and storage [18]. The following elements such as material composition, *PS* and shape, moisture content, pressure, and variations in temperature and humidity may influence caking development. These elements may be combined to form bonded powdery materials by certain mechanism, depending on the environmental conditions involved in a given powder system.

d) Detonation and Dust Explosion

Dust denotes very fine or tiny divided solids that may turn out to be airborne beginning from the original state devoid of any physicochemical changes other than fracture. Dust is made up of tiny solid particles carried by air currents [18].

Among all the problems associated with dust emission, such as health hazards, abrasion damage to equipment, impaired visibility, unpleasant odors, material loss, and problems in community relations, the risks of dust explosion and fire are one of the greatest concerns in many industrial fields because of their destructive impact on both human beings and factory installations. The simplest and best way to minimize the explosion chance is by good maintenance practices, for example, by ensuring that equipment, bins, and transport systems are dust tight, or by applying cleaning procedures in order to removing extraneous combustible material and solvent from work areas and equipment.

IV. Tea Packages and Tea Bags Selection

Tea is packaged in tea bags made by form-fill-seal (FFS) technology from light-weight permeable tissues. The materials are porous to allow the dispersion of the tea flavor; hence they are unresisting to moisture and air and require additional layer of packaging. A secondary package made of aluminium foil is used to contain numerous tissue tea bags acting as a barrier between product and the environment [23]. They are further composed together inside a rectangular box. Tea packaged inside a paper box is sometimes protected by another layer of package such as transparent cellophane [24]. Tea bags are mostly preferred in comparison with loosen tea because of ease in handling and preparation. This is also due to consumer preference, blending possibility of diverse ingredients with equal particle distribution in a single tea bag as desired by the consumer. Herbs consumed in tea bags also have therapeutic benefits and there is also great demand in value added tea hence yielding more profit to beverage industry [25]. Amongst others, the design of tea bag, extraction proficiency and functional behavior are the most essential qualities, as they can influence the efficiency and acceptability of the tea bags by consumers based on some important parameters like type of paper, used, its pore size, shape, loading capacity, holding time and temperature, and so forth [25]. The following are considered in selection of tea bags:

a) For tea bags to be heat sealable, fiber used in tea bag are processed with synthetic polymers to form papers and there must be good tensile strength at sealing joints, wet strength should be high, it should not affect flavor infusion [26].
b) Polypropylene tea bag filter paper has been replaced with the cellulosic tea bag filter paper which are made from nonwoven fibers which are based on cellulose obtained from the seeds of jute or abaca trees or cotton or stem fibers of hemp [27].
c) Cellulosic tea bag filter paper has high tensile strength and is highly porous that provides high durability and protective layer for any adsorbent. It is also cheap and nontoxic.

d) Air permeability is high, has hydrophilic nature and fast water absorption that is, 2s which decreases the longer extraction time and poor wettability of the polypropylene filter paper.

V. Tea *IK*

The best standard technique for preparation of tea is infusion of some quantities of tea in a tea bag into boiled water in a tea cup [28]. Tea infusion is a solid-liquid extraction process with great importance because of high global consumption tea rate as a beverage.

A. Effect of Dipping Temperature, Infusion Time and Dipping Frequency of Tea IK

The key factors influencing the *IK* of tea bags are tea bed brought into being inside the tea bag, tea bag shapes and size, stirring outside the tea bag, *PS* of tea granules, tea bag loading, brewing temperature and dipping frequency [29]. Some findings observed that a rise in temperature and dipping frequency (rate) of tea bag in hot water resulted in an increase in the *IK* of tea bags [29]. Hence the infusion profile of tea is being enhanced with increment in brewing temperatures and reduction in *PS* [3]. Double chambered tea bag also enhanced the swelling and *IK* whereas single layered tea bags exhibited the lowermost kinetics and a rise in tea loading in tea bags also give rise to reduction in *IK*. It has also been observed that general effects of proportion filling of tea granules and height of tea bed in a tea bag affects tea *IK* the most. The infusion profile also differs for various brands, which can be because of disparity in manufacturing and processing techniques for various brands [3].

The infusion time depends on whether it is loose or tea bag, tea bags takes less infusion time for the extraction of phenols and antioxidants as compared to loosen tea. However, the highest infusion period of time for tea bag is <30 s to 2 min, and this was realized in black Assam tea [29]–[31], and it was observed that greatest polyphenols were extracted from black tea and they are mostly released within 5 min of steeping and giving it some extra time does not seem to have ample effects on the extraction rates. On the other hand, green tea had an exception as polyphenols was released within 2–3 min. Peppermint tea was recorded to have the highest antioxidant capacity followed by green, orange, pekoe, red rooibos, and chamomile tea.

B. Role of PS in Tea Infusion

PS reduction improved the swelling capacity and *IK* of tea in a tea bag [29], [32]. This result was in agreement with observation made by Raosaheb [33] that particle fractions with smaller *PS* (500–250 μm) showed faster infusion. Reduction in *PS* enhance swelling which increases the tea *IK* in tea bags.

C. Permeability Effects on Tea IK

Researchers studied the characteristics of tea bags such as wettability, thickness, surface topography, pore size, porosity and permeability influence on *IK* of tea bags, keeping all other parameter that affect tea *IK* constant [24]. It was also observed that a general trend exists among the materials with increase in permeability due to increasing porosity [24]. The highest permeability effects were seen with the woven nylon paper, after which comes the nylon hybrid, then followed by the PLA, cellulose/PP and cellulose. The low permeability standards of cellulosic papers were ascribed to the uneven pore structure, reduced pore sizes and small porosity of the paper and the higher permeability of woven nylon was attributed to its higher %porosity and uniform pore structure. Hence, the tea bag pore sizes and tea bag porosity will influence the permeability of a tea bag paper.

When studying the effect of permeability of a tea bag paper on *IK*, it was noticed that although the original infusion rate of woven nylon tea bag paper was faster (1.2 times) than other tea bags indicating effects of high permeability and afterwards, the difference in the rate of infusion fades out [24]. Hence, tea bag paper has insignificant power on tea *IK*, notwithstanding having considerably different permeability standards [24]. Consequently, the permeability of tea solutes via tea bags do not have a substantial power on its *IK*. These findings are in line with reported studies [34], as caffeine passes thru a tea bag membrane. It is also important to note that although negligible, the preliminary infusion rate of tea is very important as very many consumers have a custom of dipping the tea bags for less than one min.

VI. Effects of *PS* on Extraction Efficiency

Makanjuola [35] investigated on influence of *PS* and extraction solvent on antioxidants properties of extracts of tea, ginger, and tea–ginger blend. From the research, it was submitted that *PS* of powder particles can influence the extraction efficiency of antioxidants present. Furthermore, maximizing antioxidant extraction efficiency depends on the solvent involved and the nature of the concerned antioxidant. These following observations was done according to Makanjuola [35] with respect to *PS* and extraction efficiency:

1. The *PS* that maximizes antioxidant property is a function of solvent being used.
2. The measured antioxidant properties can be influenced by the optimum *PS*.
3. The least *PS* of powder particles may not often result in the highest antioxidant property.

VII. Novel Technology for Tea Production

Instant tea powder is regarded to be the entire soluble solid of tea that is developed as a novel and fast-growing product in most part of the world. There are numerous processes that involve the viable and commercialized production of instant tea. These include tea leaves blending, extraction with boiling water, aroma recovery, soluble solids concentration, aroma restoration and dehydration.

Someswararao and Srivastav, [36] developed a new process for production of instant/soluble tea from the expressed juice of fermented tea leaves. The tea leaves are subjected to withering, maceration, and fermentation process. The fermented leaf is pressed to expel a part of juice containing soluble solids. Afterwards, the juice is being heated, then centrifuged and vacuum dried to obtain soluble/instant tea powder. The pressed leaf residue is dried using vacuum/hot air drying to get low grade conventional tea granules [37]. This process can be used by manufacturers for simultaneous production of instant tea and black tea. The process is economical as both extracted juice and pressed cake are converted into value added products.

VIII. Future Prospect

Recent research and advancement in food process engineering provides good opportunity for the production of novel value-added products that are both nutritionally beneficial to the consumers and easily processed for consumption. Different tea forms ranging from black tea to flavoured instant tea are sold commercially. These products are package in tea bags or as loose tea, but due to consumers demand and the rate of infusion of such tea, there is need to produce tea with small *PS* that enhance the rate of infusion even in low temperature of the liquid as temperature has effect on the *IK* of tea. There is also needed to package tea in tea bags that are environmentally-friendly, economically-friendly, non-toxic and most importantly enhance the rate of tea infusion. Instant tea tablet which are equally flavoured with herbs that are medicinal can also be developed at affordable prices for the final consumers. Some consumers may also prefer iced tea that can be produced and packaged in tetra packs which can be refrigerated and sold to the final consumers.

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Conflict of Interest

Authors declare that they do not have any conflict of interest.

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