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Constriction and Broadening are Phases, Just Keep Moving like Ultrasound

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The laboratory life is full of workload and it wears you out. The life out of the laboratory is also similar; the stressful environment chokes you out. It feels like you have been squeezed by life, and can't breathe. But you have to just keep moving with patience, to reach a relaxing phase of life. This manoeuvre helps in surviving hard times by eradicating the negative vibes from life. These small steps makes you feel like you have achieved something. I find this phenomenon of life similar to ultrasound processing in food processing. Food processing is the term used to describe the process of transforming agricultural produce by applying various unit operations into products having high stability, portability, utility, high value addition and which are highly safe for consumer consumption. We already know about ultrasound through its application in hospitals or clinics, but in recent years, the technology of ultrasound has also been used in food sector. So what basically is an ultrasound? To understand ultrasound, firstly we should know that sound travels in wave form resulted from the back and forth vibrations of particles of medium (air or water) through which sound is moving. This back and forth vibration of particles creates a region where particles are closest together known as compression and another region where particles are furthest apart known as rarefaction. One compression and rarefaction together makes a cycle of sound wave. So to quantify sound, a term "frequency" is used which is the measurement of number of complete wave cycles produced in one second and it's unit is hertz (Hz). Humans can only sense sound from 20 Hz to 20,000 Hz. So basically, ultrasound is just a sound wave which has a frequency higher than the audible range of humans (> 20,000 Hz). Just like ultrasound propagates by alteration of compression and rarefaction cycles, we must keep going ahead when it is the constriction phase of life, because only mobility will lead you to the broadening phase of life.

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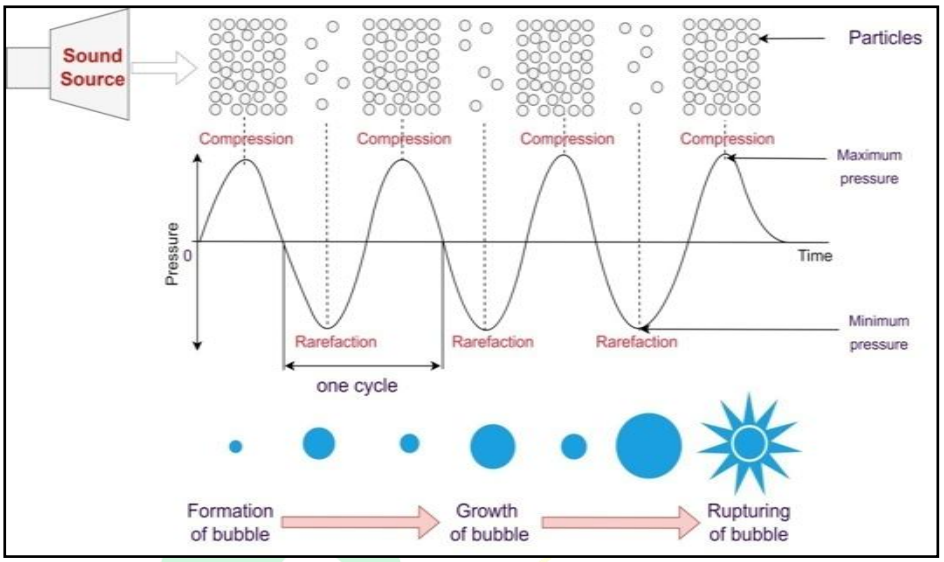

Let me take you through my life full of contractions and expansions. As a PhD student, I have been working on the processing of Stevia leaves with the novel technology of ultrasound treatment to extract Steviol glycosides. Steviol glycosides being a natural non-calorie sweetener, serves as a sugar substitute in food and beverage industries. The act of applying ultrasound to food samples is known as sonication. When ultrasound propagates in a liquid medium, cycles of compression and rarefaction create bubbles that expand further and eventually rupture and this phenomenon is known as cavitation. The bubbles have a lifespan of only a few microseconds and their diameter is also in micrometers. This cavitation creates a local zone of high temperature (up to 10,000 Kelvin) and pressure (upto 1000 atmospheric pressure) which alters the structure of cells close to these zones. This cavitation enhances the mass transfer between the food matrix and solvent which is utilized in the extraction of various components from food. The whole process occurs in two steps, firstly the solvent enters easily into the food matrix due to the disruption of the cells and in second step, the extract is wash out from the food matrix due to increase in area of surface. Many factors influence the effect of ultrasound like parameter of food (total soluble solids, pH, water activity, density, viscosity) and treatment (frequency, wave length, time and temperature).

The device which is used to give ultrasound is known as sonoreactor/sonicator. There are mainly two types of sonicators based on the mean sound intensity namely; probe type system and water bath/ tank type system. Mean sound intensity is the power carried by sound waves per unit area in a direction perpendicular to that area and has units of watts per square centimeter (Watt per cm^2). There is an electromechanical component in the sonicator known

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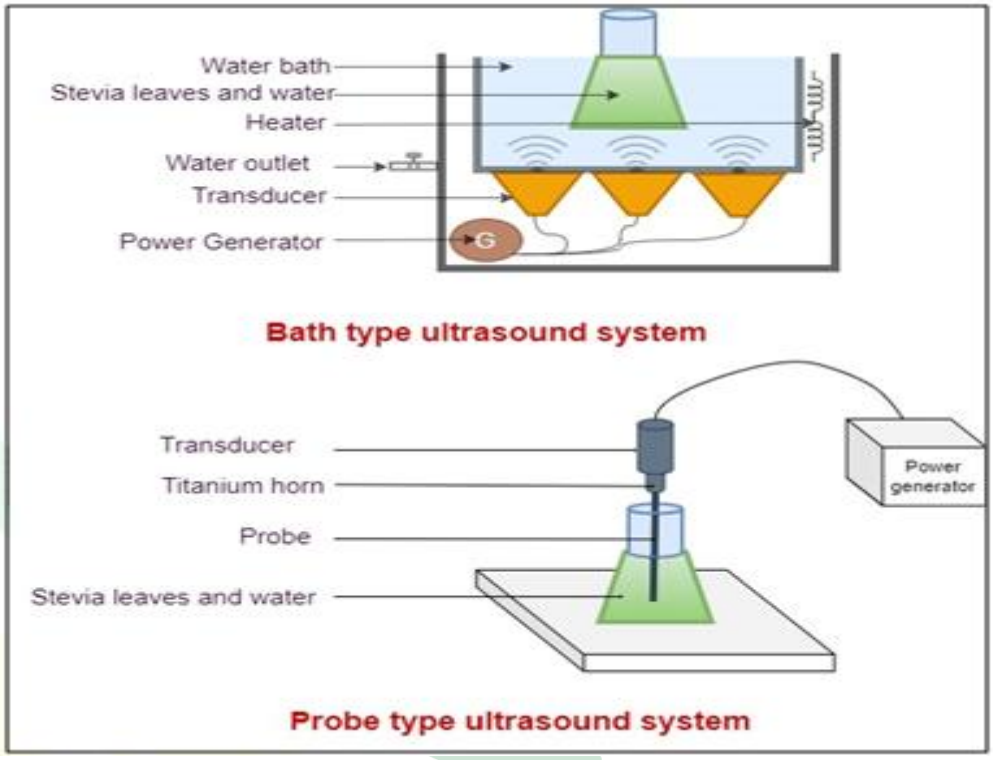
as transducer which converts the electrical energy into the sound energy. In probe type system, the titanium cylinder which is in direct contact with the processing medium consist of a single transducer, which generates the ultrasound, while in bath type, the transducer are situated normally on side or in the base of the bath. The probe type sonicator has high intensity (W/m^2) at the probe surface, while tank-type ultrasound usually has lower sound intensity to prevent cavitational damage to the bath walls. At laboratory scale, the smaller tip diameter of probe (upto 35 mm) has shown generation of high ultrasonic amplitudes but care must be taken as there can be very fast temperature rise of the sample. Though the bath type ultrasound systems are simple in handling and have advantage of being inexpensive, these are used less because these cannot produce the same results when used repeatedly under the same circumstances.



As a food process engineer, I am extracting the Steviol glycoside by treating it with ultrasound combined with mild heat which is known as thermosonication. Thermosonication is excellent alternative to conventional thermal treatment as the cavitation effect due to high pressure and temperature zones leads to breaking of cells walls, disruption and thinning of cell membranes. Overall, thermosonication is a non toxic, safe, low cost and efficient energy output technology.

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So I remember, on the very first day of experiment the sonicator in our laboratory broke down. I just hustled to find out another sonicator in the campus and in another few hours I got the permission to perform my trials in another laboratory. At this compressing stage, if I haven't moved forward like ultrasound, I wouldn't have stepped into the relaxing phase. Therefore, I suggest everyone to be like an ultrasound, by increasing the converting your thoughts directly into actions and deactivating the unwanted microorganisms like beliefs from your life. Talking about the research, the sonication of Stevia extract showed higher extraction of Steviol glycosides in comparison to the traditional extraction methods which have been time consuming. Various researches have also reported that the ultrasound assisted extraction is a replacement to the conventional extraction methods. Thus, ultrasound assisted extraction has shown better results in terms of extraction and quality of extracts due to the cavitation effects.

Whether it is life or processing of food, be like an ultrasound with spark in your heart to drive you to the next phase. This basic fundamental makes me to enhance the qualities of life even in my small world.