CONCEPTUAL EDITORIAL

Fruit Juice Concentration – Future Opportunities and Challenges

Juices and pulps are produced from a wide variety of fruits and vegetables around the world, while some medicinal plants and herbs are also used for preparation of extract of beneficial bioactive compounds. These juices and extracts contain very high proportions (upto 75-90%) of water. Further, due to their seasonal nature, these commodities cannot be produced round the year in various parts of the world. Preservation, storage, transportation and marketing of single strength juices, pulps and extracts, is, not at all economical due to the presence of large quantities of water. Under these circumstances, the technology of *concentration* offers many advantages. Concentration has many applications in fruits juice, alcohol, coffee, vinegar and dairy industries.

In fruit juice industry, *concentration* refers to a process of separation of water (or any other solvent) from the solids of the pulp, juice, extract by making use of the three basic methods i.e. evaporation, freezing and membrane technology. This, not only provides microbial stability, but also reduces the costs of packaging, transportation and storage of pulps and juices by reducing the bulk of the material. Concentrated juice, contains far less water than normal, or "not-from-concentrate" forms of juice.

Citrus (including oranges, mandarins, limes, lemons, grape fruits etc), apple, grapes, kiwifruit etc. are the most widely studied fruit juices for the purpose of concentration. Citrus juice concentrates are being manufactured at commercial scales since the beginning of 20th century in some parts of America and later spread to the rest of the world. With the increasing awareness and preference for natural fruit juices, the demand for concentrates of various fruit has risen immensely during the last few decades. Today, many of the fruit juices are concentrated at commercial levels and the production has also increased as per the specific demands. This trend is also thought to climb in near future due to the use of concentrates in preparation of various health enhancing products. Nevertheless, a number of challenges still exist before the researchers to address.

The common problems experienced during concentration of juices and their storage include the formation of gel at higher concentrations, quality losses during evaporation especially those of the vitamins and flavor volatiles, non-enzymatic browning during concentration as well as storage, formation of undesirable flavor compounds etc.

Use of clarified juices for the purpose of concentration has been suggested as practical solution to address the problem of gelling of juices at higher concentration. Clarification is generally done by using pectinase, cellulase or mixed enzyme formulations etc. enzymes treatment followed by filtration under suction / pressure through filter press. This method is quite feasible and effective, but addition of enzymes to juice is sometimes, not regarded acceptable. Use of immobilization techniques have been suggested to overcome such issues. Fruit juices also experience high losses in colour, aroma volatiles and nutritional value (vitamins etc) during the process of evaporative concentration. These losses are generally directly proportional to the exposure of the product to high temperature and residence time. Centritherm Evaporator wherein the residence time is extremely short, is an excellent solution for handling this type of problem.

Browning of citrus juices and beverages during preparation as well as storage has been recognized as a big problem for the fruit processing industry Maintaining the product at low temperature during processing as well as storage is the most common mean suggested to avoid colour and flavour deterioration of fruit juices concentrates in long term storage. However, an alternative for browning reduction in lemon and orange juice concentrates was developed recently that involved removal of (nutritionally less important) reaction substrates by cation exchange resin treatment of single strength juices prior to concentration. Which can bring about 3 to 4 fold reduction in browning of concentrates. For addressing aroma losses in concentrates, installation of aroma recovery systems and cut-back methods, have been suggested by various researchers. Fouling of membranes is yet another problem faced during membrane concentration. A lot of work is being done to improve the capacity, quality, reusability of the membranes. In freeze concentration, fluidized bed freeze concentration, cryogenic freeze concentration, progressive freeze concentration etc are being developed for various heat sensitive products.

It is imperative to use evaporative concentration to remove major bulk of the water from the juices at commercial levels, still low temperature concentration and use of membranes hold promise for future research in this area. Further, use of microwave assisted concentration of juices, use of vacuum systems, cryogenic technology, low residence time concentrators etc. are the suggested areas that hold promise for future research on this subject.

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