

Vacuum Frying of Foods: An Overview

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The future of Indian snacks market can be gauged from the fact that snack industry is expected to propagate with double digit CAGR till 2024. Presently, the country's snack market is worth of more than 11.08 US\$ billion and is undergoing tremendous growth cycle as many global companies are occupying their presence in the market. The major snacking foods are salty snacks, confectionary snacks, snack nuts, savory snacks etc. The current challenge of the industry is to produce healthier snacks (with reduced fat, sodium and sugar) while retaining their unique quality characteristics. Hence, approach of innovative or advanced technologies for processing like vacuum frying has become inevitable.

Conventional frying involves cooking in a hot oil bath (170 - 190°C), whereas, vacuum frying is a process at reduced atmospheric pressure (< 100 kPa). At such lower pressure, the boiling point of oil and water gets reduced as compared to atmospheric pressure, thereby allowing the frying temperature to be less than 90°C. This resultant low temperature frying assists in preservation of the nutritional, aroma, color, textural and organoleptic characteristics. Moreover, the quantum of oil utilized is also reduced significantly as compared to frying in normal atmospheric conditions. Lower acryl amide content, carotenoid retention are additional unique features reported in the final product. The trending vacuum fried food products are beetroot, okra, potato, jackfruit, apple, banana, pea nuts, bitter gourd etc.

Working principle

A typical vacuum fryer made up of three basic parts (a) vacuum frying chamber (b) refrigerated condenser (c) vacuum pump as shown in figure 1. The heating of oil can be done by circulation through an external heater. The food to be processed shall be kept in basket loaded in the frying chamber which is above the surface

of the oil tank. The basket is then sunk in the hot oil and subsequently vacuum is created in the frying chamber using vacuum pump. Along with negative pressure, vacuum pump aids in the removal of non-condensable gases. Subsequent to the addition of food product, temperature of the oil ceases, however gradually oil recuperates its initial frying temperature. When the frying is completed, fryer is vented for the steady release of vacuum. Condenser is placed to collect the evolved steam for condensing on a cold surface. The excess oil is drained thereafter and the desired product is taken for further unit operations.

Figure 1: Schematic diagram of vacuum frying system.

Opportunities and challenges

The recent Covid-19 pandemic has substantially influenced the snacking habits of Indian consumers. The ready-to-eat savories became instant companions, offering gratification as well as a sense of contentment. The snack companies are very conscious in producing variety of sugar-free and immunity-strengthening snacks by incorporating nutritional preference to the commodities. Subscrip-

tion-based healthy snacks with advanced technology intervention also are on the surge. During pandemic, when most of the economic sectors were adversely affected, the snacks market has showed positive impact in monetary terms. Vacuum frying has many advantages over atmospheric frying in terms of resource (oil/fat) management and final product quality management. Intervention of such advanced technologies has great impact on health and diet conscious among the public during pandemic, and this trend expected to progress long term, with promising technologies.

Despite of several advantages, few challenges are associated for the startup industries trying to establish industrial vacuum frying setup. The prime limitation is the higher initial investment cost in comparison to the conventional frying plant. Although plants having large capacities are available commercially, the un-availability of small capacity vacuum fryer assemblies poses another challenge. This is the hindrance for the small/medium entrepreneurs and industries to espouse vacuum frying technique for their business establishment.

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