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Pooja MR
Kelappaji College of Agricultural Engineering and Technology, Kerala Agriculture University, Thrissur, Kerala, India

Chethan BJ
Kelappaji College of Agricultural Engineering and Technology, Kerala Agriculture University, Thrissur, Kerala, India

Corresponding Author:
Pooja MR
Kelappaji College of Agricultural Engineering and Technology, Kerala Agriculture University, Thrissur, Kerala, India

Sous: Vide food processing flattering consumers fascinating cuisine

Pooja MR and Chethan BJ

Abstract
Generally, the most common methods to cook vegetables and other products are boiling, named also traditional cooking and steaming. Both of them require high temperature (around 100 °C) and the presence of oxygen which can lead to a decrease in nutritional substances and can influence the activity and bioavailability of active compounds. Sous vide processing is one of the main cooking processing which increases the stability of the food with shelf life. In addition to traditional way of cooking and ensure food safety. Sous vide is a technique that provides wholesome foods with minimum food safety risk. The hermitically sealed plastic bags form oxygen barriers, slows down the growth of aerobic bacteria, delays spoilage. Sous vide technology enables cuisine solutions to cook the food for optimum taste, colour and texture with minimum loss of nutritional properties. This could be a promising technology as there is a growing demand by the consumers worldwide for high quality foods.

Keywords: Saus vide, vaccum packaging, temperature, pressure, time

1. Introduction
Vegetables contain an important role in our diet because it has water, phytochemical compounds and fiber content. These compounds help to effects against tumour and cardiovascular diseases. There are many types of vegetables, which can be eaten directly. In cooking the product gets softer and it gelatinizes the starch and improves the digestibility of fiber. Heat treatments reduce the inflexibility, mainly by the β-elimination reaction of pectics substance. In addition to depolymerisation and solubilisation of pectin materials, the phytochemical compounds could be destroyed or leached into the water media during cooking treatments (Bernad *et al*., 2014) [19].

The most common boiling method of vegetables and other products are called as steaming and traditional cooking. Both traditional and steaming require high temperature (around 101 °C) and with presence of oxygen which may reduce nutritional value, bioactivity and increases microorganism population which causes health issues (Garcia-Linares *et al*., 2004) [5]. In order to maintain the original quality, it is required to process at relatively lower temperature. It is suggested that the loss of molecules in vegetables, such as anthocyanin, ascorbic acid and polyphenols were lower during vacuum conditions (Baardseth *et al*., 2010) [1].

Nowadays, for improvement of minimally processed foods in spite of developing new research on processing technology particularly in-between to minimally process and convection thermal processing. A new and promising technology is sous vide processing (Kuriakose *et al*., 2016) [8]. Sous vide means “under vacuum” is a French term and it is defined as the raw materials or uncooked materials with intermediate food, that are cooked in particular temperature and time inside heat stable laminated pouches. Food scientists have been interestedly studying the sous vide processing of foods at 1990s and mainly interested to increase the storage-life of minimally processed foods by using sous vide cooking (Humaid *et al*., 2008).

Sous vide is characterized as temperature below 100 °C with the absence of oxygen. The main advantage of this oxygen absence and lower temperature is to reduce damage to thermolabile compounds, which could improve the final quality. Moreover, lower temperatures reduce the production of acrylamide content and it provide high retention of flavor in fresh produce and less loss of pigments (Bernad *et al*., 2014) [19]. In case of Sous vide cooking method the foods are keep in the vacuumised heat stable pouches and slowly cooked under controlled conditions of temperature (around 91 °C) and time of 30 minutes (Baldwin, 2011) [3]. Sous vide provides unique advantages in cooking because whole pouches maintains same temperature and product come out from sous vide cooked has same flavor and colour retention.

Nutrients are also retained which gives good sensory attributes to the consumers (Bernad *et al*., 2014) [19].

Sous vide processing of foods are packaging in vacuum sealed plastic pouches for the low temperature and long time for cooking the foods. Sous vide cooking is different from other cooking methods like raw foods and are kept in vacuum sealed plastic pouches, ii) the cooked food has precise heating to foods (Singh *et al.,* 2016) [17].

Sous vide is a technique that provides wholesome foods with minimum food safety risk. The hermitically sealed plastic bags form oxygen barriers, slows down the growth of aerobic bacteria, delays spoilage. Sous-vide technology enables cuisine solutions to cook the food for optimum taste, colour and texture with minimum loss of nutritional properties. This could be a promising technology as there is a growing demand by the consumers worldwide for high quality foods.

2. Principles of sous vide processing

Sous vide processing mainly uses three principles a) By using heat stable vacuumised laminated plastic pouches for reducing food from leakage and avoid spoilage of food constituents (e.g. Vitamins, water, odor, and flavor, volatiles, usually lost during Traditional cooking) (Creed. 1995) [22], b) Using vacuum principle air is removed to prevent from oxidation of food, c) By using less temperature, cooking reduces the over cooking of food and reduce breakdown of food constituents (Tansey *et al*., 2005) [18]. It also uses basic principles such as pressure, temperature, and time.

2.1 Pressure

It is one of important parameter, in which pressure is determined by the power of vacuum packer. The vacuum packers extract air from sous vide bag, kneading the bag tightly against the food, sometimes even compressing the food. Generally, in vacuum packaging the different gauges are fixed for different pressures. For hard items, such as carrots, high pressure is required so that oxygen can be easily removed and the plastic is as tight against the vegetable as possible to maximize surface contact with hot water. For items like delicate food such as fish, use less pressure so that there will be less chance of puncture to food as well as package material (Rondanelli *et al*., 2017) [23].

2.2 Temperature

The temperature of sous vides cooking are always less than 100 ºC or below that of the simmering water, which is about 87 °C to 93 °C. In most of sous vide cooking highest temperature is almost without exception, is 85 °C, and this is exclusively for vegetables. Meat and other fish cooking temperature are more varied. In fish, proteins generally are delicate and protein will be denatured and coagulate hence cook at 6.6 °C lower than the other food products. In case of meat, cells begin to contract and thus squeeze out water and become tough at about 60 °C. At about 70 °C, the meat squeezes much of its moisture, but cells are easier to pull apart and the collagen will have begun to melt into gelatin. Cooking of braise cut sous vide at 65.5 °C for longer time. For tender breasts of poularde 62 °C, but thighs are cooked at 64 °C. These are all basic temperatures in sous vide processing (Keller and Thomas, 2008) [24].

2.3 Time

Time is one major factor in cooking of food, in conventional cooking no definite time is maintained. In sous vide processing however; once the food reaches the fixed internal temperature and the temperature is maintained even when left in the water. And there is no carryover cooking when food is removed from the water. In this type of cooking, for particular food preparation the temperature and time are fixed (Mohan *et al.,* 2016) [11].

3. Basic techniques

In sous vide processing the main intension is to maximize the food taste, quality, and increases shelf life of sous vide cooking products, and minimize the risk of food pathogens. In this type of cooking mainly two techniques are used cook freeze or cook chill and cook serve or cook hold. In Cook serve cooking the first step is to prepare for package and then vacuum packaging and heating the packaged food and serve for eating. In cook chill sous vide cooking, it is same as the cook serve cooking but only difference is instead of heating, the rapid chilling was used and stored in a refrigerator (Baldwin, 2011) [3]. Sous vide mainly consists of three stages, preparation of packaging, cooking, and finishing.

3.1 Preparation of packaging

The first step in preparing food for sous vide is same as other cooking methods with minor difference in cooking, it uses separate preparation surfaces, chopping board, utensils e.g. weighing balance, wrapping and packing materials for raw and ready to eat foods. Thoroughly clean and sanitize the surface before and after use. Maintain separate cloths for raw and ready to eat food preparation areas. Weigh and prepare ingredients. Consider the consistency of the portion as a control measure such as weight; size and thickness are important factors. And main thing is to standardize the proportion of ingredients before going to sous vide cooking (CUI, *et al*., 2021; Galimpin-Johan, 2007) [4, 25].

3.2 Vacuum packaging

Vacuum sealing is one of the good packaging machines in which packaging material heat is transformed efficiently to food by using water bath or steam oven. By using this type of packaging in sous vide cooking, eliminates the risk of recontamination during the storage and inhibits the off-flavors from oxidation (Hong, *et al.,* 2015) [26]. Use separate designated and clearly identifiable vacuum packers for raw and ready to eat food, and food grade quality pouches to be used for heating to the maximum temperature required. Each pouch to be securely sealed and seal integrity to be checked for each pouch, avoid air bubbles which can cause uneven cooking (Mori *et al.,* 2021) [12].

3.3 Cooking

In most of the cases cooking was done in a convection steaming or water bath. The convention steaming allows large quantities of food to be cooked at a particular time, but in this case the food is not cooked properly due to unevenness of surface contact with food. Hence, water bath is mostly used. Check whether all the equipment working correctly on the regular basis, for e.g., water bath level and temperature by using probe (Hui Ding, 2020) [6]. In the entire product, the core temperature should be identified for maintaining the consistency of required temperatures. Time, core temperature of food, size of the product combination must be documented, otherwise it's very difficult to control the time and temperature and food may get over cooked. Preheat the water bath before placing of sealed pouches, and set the water bath

2.5 °C above the fixed temperature for achieving the correct core temperature. Too much overloading leads to uneven cooking and food must be completely submerged in water bath. After cooking, carefully remove the bags and serve immediately or keep it into refrigerator (Singh *et al.*, 2016) [17].

3.4 Chilling for late use

The chilling can be done before and after cooking, in cook hold and cook freeze sous vide processing food is rapidly chilled in its vacuum sealed pouch and frozen after pasteurization (Garcia-Linares *et al*., 2004) [5]. Finally keep the food chilled until ready for serving (5 °C or below, ideally 3 °C or less) (Roberson *et al.*, 2006) [20].

3.5 Finishing for Service

After cooking in sous vide, essentially food is cooked in a controlled condition of temperature and time in vacuumised pouches. Most food cooked sous vide has the appearance of being poached (Llave *et al.*, 2017) [10]. Before going to serve reheat the pouches and then serve for eating.

4. Equipment used in sous vide processing:

In France, Belgium and Netherlands sous vide processing are used, mostly in high-class restaurants and mass catering. In catering and restaurants, the production volume is different and also the product types are totally different in the two types of catering, the equipment that is used is also different (Schellekens. 1996) [16], but nowadays it is used in all over the world for improving quality of foods and shelf life. A Sous Vide processing is a partly continues process while cooking in a bulky scale and discontinues in small restaurants. Sous-vide processing needs many types of equipment for cooking foods, vacuum packaging machine is an important machine for packing of foods under a vacuum condition, probe tip thermometer in water bath and convection steam oven to maintain temperature, for vacuum packaging a vacuum sealer and water impermeable heat stable plastic pouches (Mohan *et al.*, 2016) [11]. The cost and quality of these equipment's depends on availability.

4.1 Digital thermometers

A thermometer is a device used to measure temperature gradient of food. Accurate temperature control is very important in sous vide processing. In this cooking, the degree of consistency and precision of cooking temperature varies with the food products. Pasteurization times depend mainly on temperature, many proportional integral derivative-controlled water baths are off by 1 °C or more; the water bath temperature set at 60 °C might only be 59.5 °C. The chicken breast needs 15 minutes more and 15.25 mm thick piece of fish will cook in 16 to 17 minutes at any different temperature from 44 °C to 61 °C (Li, 2013) [9]. But for an egg, low temperature is maintained because in egg protein will be denatured at high temperatures. Maintaining precise, constant temperature is more critical. A high quality thermometer has a probe tip thermometer sensitive to +0 °C. Probes with a thin needle (0.5 mm) are best for a variety of foods thicknesses, and it is very important for finding out the food core temperature (Naveena *et al.*, 2017) [13].

4.2 Vacuum Sealers

It is the method of packaging air is removed from the package prior to sealing. In this processing the packaging materials are selected based on suitability for sous vide cooking. It should be high barrier film that is impermeable to oxygen and thick enough to resist puncture from bones and sharp food edges (Fagan *et al.*, 2004) [26]. The thickness of bags is recommended to be at least 2mm or higher to be oxygen impermeable. Low density polyethylene (LDPE) and high-density polyethylene (HDPE) bags are acceptable for sous vide cooking. Using vacuum pouches specially made for this type of cooking are recommended. In this cooking zip lock type of bags should not be used because sometimes it affects the product (Rinaldi *et al.*, 2012) [14]. Mainly two types of vacuum sealers are used in sous vide, external sealer and chamber type vacuum packager. In external sealer, bag is placed on the outside of the sealer, air is withdrawn and sealing occurs outside of the sealer. The chamber type vacuum packager, bag is placed in packer, and once the lid is closed air is removed from both the chamber and inside of the bag (Gormley, 2002) [27].

4.3 Convection Steam Ovens

Convection steam ovens use circulating heat and steam to prepare foods. In this oven cook the large quantity of foods, cooking times and loss of product moisture and shrinkage are also reduced (Rinaldi *et al.*, 2012) [14]. To create the water vapour, these machines either use a steam generator or inject measured amounts of water at periodic intervals to the heating elements, resulting in more controlled temperature and humidity, resulting in gentler cooking methods (Humaid *et al.*, 2020) [7]. Pre-packaged sous vide foods can be placed into the oven directly, or, foods may be pasteurized first, and then packaged after the process (Tansey, *et al.*, 2005) [18]. In almost all cases food is cooked under water bath or conventionally steam oven. Conventional steam ovens allow large quantities of food to be prepared, but don't heat uniformly enough to serve. (Sheard and Rodger, 1995) [28] found that none of the convention steam ovens they test heated sous vide pouches uniformly when fully loaded.

4.4 Water immersion circulator

Water immersion circulator circulates water at a particular speed and it maintains a temperature over the container, also volume of water (often up to 50 litres). In most cases the bioscience machine has 9 LPM (Liter per minute) to 15 LPM was used. For restaurants, the more expensive immersion circulators are a better alternative since they are more durable, versatile and have large capacity (Kuriakose *et al*., 2016) [8].

5. Microbiological safety of sous vide processing

The food is affected mainly by microbiological activities because of availability of oxygen, over and under cooking, low and high temperature and refrigerated storage temperature (Church and Parsons, 1993) [29]. Microbiological hazards of food are commonly virus, bacteria, and parasites. The bacterial hazard can be controlled by good food handling practices, and maintaining the cleanliness of the sous vide products. Only use the freshest, highest-quality ingredients when preparing sous vide packages. This can significantly lower initial microbial levels, extending shelf life and product freshness. The recommended cooking treatments is 10 min at 90 ºC, this inactivates all facultative pathogenic and most spoilage microorganisms, and some *clostridium botulinum* spores. The product is kept at a controlled chill storage temperature to avoid growth of photolytic bacteria, which can occur if temperature maintained at 10 ºC. The shelf life of sous vide products is basically up to 21 days at 4 ºC (Tansey and Gormley, 2005) [18]. The control of all the hazards HACCP (Hazard Analysis Critical Control Point) system is recommended to control safety hazards associated with sous

vide processing.

6. Conclusion

The sous vide processing is very promising technology for cooking foods under vacuum condition. It is one of the powerful tools in the current kitchen, particular or accurate temperature control gives a better reproducibility, and increases shelf life of sous vide products. Sous vide provides uniform texture of food and it gives a good flavor, firmness and aroma compared to other cooking methods. It allows, controlling the cooking of product and reduce the off-flavours from oxidation. Sous vide reduce the loss of nutrients to the cooking medium. Vacuumised packaging improves heat flow, to extends storage life of foods by reducing the risk of contamination, reduces loss of nutrients and it has a great possibility on retaining the bioactive vegetable components. It gets good results to restaurants like increased service efficiency, multiple the economic value and cost of food lowered. Sous vide processing is a good scope used in industries compared to other conventional types of cooking.

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