

# A Better Nutrient Retaining Method: Comparison of Microwave with Conventional Blanching

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## Abstract

The food industry and food researchers are exploiting every possible available source and procedure for marking novel methodologies in the field of food technology, processing, and preservation. Blanching is one of the most exploited techniques for deactivation of enzymes. These methods include minimum deleterious effects on food properties like texture, nutrients, flavor etc. Blanching is not a process, rather a pre-treatment that enables enzymatic deactivation and thus stabilizing the physical and chemical properties of food. It activates many enzymes in which peroxidases and methylesterases are observed leading. Blanching can be achieved through many ways right from conventional technique to using sophisticated microwaves. The difference arises and remains in the nutrient retention and texture persistence of the food being blanched.

**Keywords:** Blanching; Conventional blanching; Microwave blanching; Vegetables, Nutrients; Enzymes

## Introduction

Food and food products are highly perishable. Thus they need to be preserved. Many preservation techniques are successfully employed and running in foods, but blanching is always involved prior to these preservation techniques for deactivation of enzymes to prevent the food or food products from self-deterioration. The main target of food preservation is to extend the shelf life of the food and blanching aids in extending the shelf life by deactivation of enzymes already present in the food. In this contemporary era, where the customers have a hectic lifestyle; consumers are more reliable on packed food. These foods are pre-treated using any of the blanching methods and then preserved for further consumption.

Blanching is a type of pre-treatment. This is performed prior to the other preservation process like drying, freezing, canning etc. It is an important step in the preservation of foods as it deactivates the enzymes present in the food that are aiding in the self-destruction of food. It also destroys the microbes present in food. It basically involves heating the food material for a definite amount of time under specified conditions.

The maximum processing temperature in freezing and dehydration is insufficient to inactivate enzymes. If the food is not blanched, undesirable changes in sensory characteristics and nutritional properties take place during storage. Blanching is done to accomplish many purposes like inactivation of quality deteriorating enzymes, enhancement of dehydration rate and product quality, removal of pesticide residues and toxic substances, expelling air trapped inside tissues, minimizing non enzymatic browning, decreasing microbial load, peeling of product, increasing extraction efficiency of bio-active compounds as shown in Table 1. Numerous attempts have been made for blanching for various fruits and vegetables along with several processed foods.

## Purpose of Blanching

### Parameters to judge the blanching

**The activity of Peroxidase (POD) and Poly phenol oxidase (PPO) enzymes:** Peroxidase (POD) and Poly-Phenol Oxidase (PPO) are easily measured as compared to other enzymes, so the effectiveness of blanching judged by the inactivation of both enzymes. POD enzyme can react with hydrogen peroxide compounds and produce free radicals,

which react with food constituents like ascorbic acid, carotenoids, and free fatty acids, causing unfavorable changes in food quality attributes like flavor, color, and texture [9-11]. The quality of the blanched product is better if there is some POD residual present after blanching. The activity of these residuals prevents any deterioration in fruits and vegetables [12].

**Ascorbic acid as an indicator of nutrient loss during blanching:** Ascorbic acid is water soluble and prone to leach out from cells. It is thermally labile and sensitive against pH changes. Therefore ascorbic acid is most preferable nutrient to check the efficiency of blanching. Preservation of ascorbic acid after blanching is a good indicator of the preservation of other nutrients [13]. The main cause of degradation of ascorbic acid during steam and microwave blanching could be enzymatic action or thermal degradation. Ascorbic acid is water soluble acid, so it is prone to leach out in hot water readily the research studies found that degradation of ascorbic acid generally depends on time and temperature of blanching process [14]. High temperature and short time during blanching (like in microwave blanching) preserve ascorbic acid.

**Colour and texture as an indicator of product quality change during blanching:** The color is associated with a product or raw material quality attributes such as freshness, sensory and nutritional, visual and non-visual defects; therefore it is important quality parameter. It also has the ability to control Millard reaction indirectly [15,16]. Colour is the deciding factor to measure the intensity of heat treatment.

The texture is a primary indicator of a product's quality for the consumer and it also determines the physico-chemical characters of the cell wall [17]. Thermal blanching affects the physical and chemical characteristics of the cell wall and ultimately the product's texture is going to be affected.

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## Methods of blanching and its principle

Blanching is further classified in various types according to methods of blanching. Different mediums and conditions are used in different blanching methods and each method has its own principle mechanism to destroy enzymes that deteriorate food quality. Blanching serves a variety of functions, one of the main ones being to destroy enzymatic activity in vegetables and some fruits, prior to further processing. As such, it is not intended as a sole method of preservation but as a pre-treatment which is normally carried out between the preparation of the raw material and later operations particularly heat sterilization, dehydration, and freezing. Blanching is also combined with peeling and or cleaning of food to achieve savings in energy consumption, space and equipment costs. Under-blanching may cause more damage to food than the absence of blanching does, because heat, which is sufficient to disrupt tissues and release enzymes, but not inactivate them, causes accelerated damage by mixing the enzymes and substrates. Blanching reduces the numbers of contaminating micro-organisms on the surface of foods and hence assists in subsequent preservation operations. This is particularly important in heat sterilization, as the time and temperature of processing are designed to achieve a specified reduction in cell numbers. If blanching is inadequate, a larger number of micro-organisms are present initially and this may result in a larger number of spoiled containers after processing. Blanching also softens vegetable tissues to facilitate filling into containers and removes air from intercellular spaces which increases the density of food and assists in the formation of a head-space vacuum in cans [18,19]. Table 2 demonstrates different methods of blanching along with their principle.

## Different blanching methods and its principle

**Conventional blanching:** It is also called hot water blanching. It is the oldest method of blanching. It is typically performed in hot water from temperature ranging from 70°C to 100°C. It is done in various combinations like HTST (High Temp. Short Time) or LTLT (Low Temp. Long Time). Various vegetables have been blanched using this type of blanching method. It basically avails the uniform blanching and thus affecting each and every part of the vegetable equally. Water is heated either directly, or with the help of steam or using the sophisticated heat exchangers. This type of blanching strictly requires hot water and more time so that the vegetable gets immersed properly

in the water and get blanched properly. Work done on Steam blanching is illustrated in Table 3.

**Microwave blanching:** The studies on microwave blanching were started being conducted since the 1940s. It is also known as a dry method in such a way the underutilized water is reduced whereas leaching is decreased, according to different studies the effects have taken into considerations of ascorbic acid, better retention of water-soluble nutrients and vitamins. It generally includes a very mild treatment of water with respect to thermal energy heat. In blanching the enzymes which are mostly known as the destructor of fruits and vegetables is commonly called as peroxidase. The inactivation of this enzyme is mostly done by this technique majorly known as inactivation process this heat resistance enzyme and further quality of these can be highly improved by this for preservation purpose peroxidase activity was recommended 3%-10%. Thermal inactivation destroys various types of degrading enzymes in peas, lipoxigenase is the enzyme found in peas sensitive as compare to peroxidase. Sometimes it acts as an indicator enzyme for blanching. Due to blanching the factor which is affected the most is vitamin C retention was lesser because of its water solubility and heat liability than compare to any other blanching. Table 4 will illustrate the work done on microwave blanching with results and remarks for better comparison of both of the conventional and microwave blanching.

**Work done on microwave blanching:** Table 4 depicts the work done.

## Microwave Blanching: A Thoughtful Approach

It is better form of blanching as it retains the essential nutrients and prevents the leaching out of the color and nutrients which is one of the drawbacks of hot water or conventional blanching (Table 4). It takes less amount of time when compared to conventional blanching. Initially, the microwave blanching was done either at home in microwave ovens or commercial home ovens. Now the trend of microwave blanching has been broadened. If comparison is made in conventional and microwave blanching the heat which gets penetrated from the food material (sample) and circulated which moreover creates a dipole moment generally known as friction, that easily maintains the internal temperature and subject less to the heat loss/thermal losses as compare to the conventional and some of the changes takes place

Purpose	Vegetable	Effect	Reference
Inactivation of quality deteriorating enzymes	Frozen carrots and Green chilli	Amount of carotenoids got increased in blanched red chili when compared to unbalance.	Ramesh et al. [1], Ramesh et al. [2], Kidmose and Martens [3]
Enhancing dehydration rates and product quality	Basil and Grapes	Steam blanching significantly increased the rate of drying of basil. Reduced time in drying of the grapes by approx. 20%	Rocha et al. [4]
Removing pesticide residues and toxic substances.	Spinach	5 pesticide residues were removed	Bonnechere et al. [5]
Expelling air entrapped inside plant tissues	Pear	Blanched pear has more soft texture as compared to unbalanced pepper	Pimpaporn et al. [6]
Minimizing non enzymatic browning reaction.	potato	Reduced red colour of potato	Pimpaporn et al. [6]
Decreasing microbial load	carrot	Decrease in yeast and mould growth When checked on the agar and broth plates	Jabbar et al. [7]
Peeling of products	Potato and asparagus	Steam blanching was used to peel out potatoes and Asparagus	Garrote et al. [8]

Table 1: Purpose of blanching.

Methods of Blanching	Principle	Reference
Hot water blanching	Products are directly immersed in hot water and product temperature gradually increases until reaching critical temperature after which enzyme and organism activities are inactivated.	Xiao et al. [16]
Steam blanching	Steam is condensed over product's surface and large amount of latent heat is transferred and temperature increases until it reaches up to critical stage after that the enzyme and organism activities are inactivated.	Xiao et al. [16]
Microwave Blanching	The heated products absorb microwaves and convert it into heat by agitation of charged molecules and again that heat increases temperature of product to inactivate enzymes and organism activity.	Xiao et al. [16]
Microwave steam blanching	This is the combination of both microwave and steam blanching where the product is blanched under steam produced by boiling of water by microwaves.	Phahom et al.
Gas blanching	Using combustion of fuels along with steam to produce and increase the humidity and thus prevent product dehydration.	Downing [20]
Ohmic blanching	Food is placed between electrodes and due to electrical resistance of food heat is generated and temperature increases and again it help in inactivating enzymatic activity.	Xiao et al. [16]
Infrared blanching	Infrared waves absorbed by molecules of food and heat is generated ultimately it increase temperature and it leads to inactivation of enzymes.	Zhu et al.

Table 2: Different blanching methods and its principle.

Vegetable	Results and Remarks	Reference
Carrots	The firmness of tissues of carrots was decreased after hot water blanching at 90°C due to loss of cell turgor and cell wall integrity	Greve et al. [21]
Brussel sprout	Amino acids decreased from 2783 mg/100 g in fresh samples to 2345 mg/100 g which was very less as compared to other vegetables.	Lisiewska et al.
Raw green Almond	It was observed that <i>Salmonella spp.</i> could not able to recover after blanching which was found 5 log CFU/g before blanching	Harris et al.
Mangos teen pericarp	Changes in enzyme PPO and enhanced efficiency of extraction of anthocyanin content from mangos teen pericarp plant	Deylami et al. [22]
Sweet bell pepper	Faster removal of water during drying Softening of the bell pepper and reduced sugar content	Sharma et al. [23]
Spinach	Blanching done at 95°C Weight loss was more because the blanching time was more. But it took less time in inactivation of enzymes. Leaching losses were more as spinach tends to leach out more of the nutrients and pigments Yield of the final product is more when compared to microwave blanching	Ramesh et al. [24]
Carrot	Blanching done at 95°C. Weight loss was more because the blanching time was more. But it took less time in inactivation of enzymes. Yield of the final product is more when compared to microwave blanching	Ramesh et al. [24]
Bell pepper	Less time for enzymatic inactivation and yield was more.	Ramesh et al. [24]
Broccoli	Decrease in ascorbic acid content of broccoli, colour changes detected via hue graph. No increase or decrease in total phenols detected	Serverini et al. [25]

Table 3: Conventional blanching.

Vegetable	Results and Remarks	Reference
Carrot	Microwave blanching enhanced nutritional quality as compared to the conventional or steam blanching. Dry matter, sucrose and carotene were 39% more when compared to other blanching techniques.	Kidmose et al. [3]
Mushroom	Heating at 85°C and Within 2 min the enzyme PPO was deactivated	Devece et al.
Red pepper	Reduction of drying time for upto 3-4 hours	Wang et al.
Capsicum annum jalapeno (Pepper)	phenolic compounds were reduced from 9.6 to 7.6 mg/ g peppers (dry weight basis) and antioxidant activity was enhanced from 29 to 42/g peppers (dry weight basis)	Dorantes-Alvarez et al. [26]
Spinach	Less weight loss than the conventional blanching as the blanching time was less. The enzymes got inactivated. Vitamins losses was reduced by 18% better retention of nutrients explained via student's t-test. Yield of the final product is less when compared to water blanching because of the evaporation of the moisture	Ramesh et al. [24]
<i>Thunbergia laurifolia</i> Linn. leaves	blanching for 4 min was adequate for the recovery of bioactive compounds	Phahom et al.
carrot	Vitamins losses were reduced by 33.5% and leaching losses were less. Less weight loss than the conventional blanching as the blanching time was less. Better retention of nutrients explained via student's t-test. Yield of the final product is less when compared to water blanching because of the evaporation of the moisture	Ramesh et al. [24]
Bell pepper	Vitamins losses was reduced by 8.5% less weight loss and more retention of nutrients	Ramesh et al. [24]
Broccoli	Microwave blanching resulted in smaller hue angle variation as compared to conventional blanching. It shows increase in total phenols due to free phenols as the consequence of heating treatment.	Serverini et al. [25]

Table 4: Work done on microwave blanching.

when sample undergoes within this treatment which causes little bit shrinkage the product gets fixed for further packaging, therefore, it was observed that microwave blanching specifically pointed on moisture as well as in context with beta-carotene content shows the better results and good retention of nutrients with less leaching losses. On the basis of consumer acceptability of food, good storage and maintenance is required, with a wide range of determined factors like an enzymatic, structural, nutritional, sensorial very important initializing step in the food processing industry.

## Conclusion

Microwave blanching is more effective than conventional blanching in terms of effective enzyme deactivation and better nutrient persistence. Microwave blanching is a very popular technique and this can be utilized as an alternative to water blanching or conventional blanching. Microwave blanching together with water (microwave steam blanching) is an efficient approach. It will have the dual positive effects of both steam and microwave making the food softer and having less deleterious effects. Modern microwave technologies are in wide use nowadays, demanded in food sector at industrial level majorly being considered as a comparison to conventional blanching. Now, in the contemporary era, newly sophisticated microwaves are there specially made for the blanching purpose only. This has made the blanching process easy, time efficient and opened the new doors for the microwave blanching industry and research.

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