

Seal Appeal:

The Nutrition, Food Safety, and Operational Benefits of *Sous vide* Technology for North American Restaurants

Introduction

Sous vide is a professional cooking method which employs plastic oxygen barriers and precise temperature controls to reduce oxidization and extend the useable shelf life of inventory by diminishing contact with aerobic bacteria. The result is a final product with superior texture, amplified flavors and enhanced organoleptic qualities. This paper examines the nutrition, food safety, and operational benefits of *sous vide* in a restaurant environment.

Unless otherwise referenced, much of the information in this paper is derived from a training program delivered by Georges Pralus, the inventor of *sous vide*. The class, “Des techniques de caisson *sous vide*” was held for the first time in the United States in David Bouley’s test kitchen in New York in April 2006. I would like to thank Chefs Pralus and Bouley for providing such a unique and wonderful learning experience, as well as paving the way for the development of *sous vide* in restaurants across North America.

History of *sous vide*

Preparing food at low temperatures in sealed vessels is one of the oldest forms of cooking. Early civilizations used clay pots were used to simmer tough meats in China, whole pigs were slowly roasted underground in Hawaii, and corn husks were tossed onto glowing embers in Mexico. One of the most traditional French preparation methods, cooking *en papillote*, involves packaging food in a parchment paper envelope. The development of stable, high temperature, food safe plastic films in the late 1960s made it possible to develop the concept of *sous vide* cooking.



Perfect, edge-to-edge medium rare lamb, cooked sous vide

The *sous vide* method of preserving and cooking in laminated plastic film sachets is generally credited to Chef Georges Pralus. Chef Pralus discovered *sous vide* cooking in 1967 while trying to reduce shrinkage on a foie gras terrine at Restaurant *Troisgros* in Roanne, France. He discovered that by packaging the *foie gras* in a vacuum sealed plastic pouch and submersing it in a heated water bath with precisely controlled temperatures, he could reduce shrinkage from 40% to 5%. In addition to the reduced product loss, Chef Pralus discovered that the sensory properties were significantly enhanced. The plastic film formed a barrier which prevented the loss of flavor ketones through evaporation, and the low temperature minimized the destruction of protein structures, preserving natural textures. Chef Pralus set up schools in Europe and Japan for chefs to learn the technique, and has taught over 8000 chefs around the world.

Applications for *sous vide* techniques are split into two general categories: centralized manufacturing plants which fabricate hundreds of thousands of high quality frozen meals under factory conditions intended for later reheating, and small scale restaurants and hotels, generally producing meal components for uninterrupted in-house usage.

Sous vide technologies have been embraced by food production companies. With properly implemented Hazard Analysis Critical Control Point (HACCP) procedures in place, products prepared using *sous vide* techniques experience longer shelf lives, excellent transportation stability, and significantly improved food safety profiles as compared to chilled or fresh food products. Cuisine Solutions (AMEX:FZN) based in Alexandria, VA is the leading US supplier of pre-made *sous vide* food products.

Employing over 260 employees worldwide, Cuisine Solutions reported earnings of \$46.2 million in 2005. The company provides frozen *sous vide* meals for airlines, trains, cruise ships, supermarkets, banquet halls, and the US military¹.

Sous vide has experienced modest use in American restaurants, typically limited to experimental or high end kitchens such as Bouley, WD-50, and The French Laundry. Restaurants have been slow to adopt *sous vide* largely because of the complicated nature of the technique, lack of training and knowledge, and the relatively high cost of vacuum packaging and precision temperature control technologies such as immersion circulators, which are prone to breakage.

¹ Hoovers (2006). Cuisine Solutions Company Profile.

Nutritional benefits of *sous vide*

Sous vide is an extremely healthful method of preparing food. Most of the benefits are directly related to the fact that food is placed in a sealed, reduced oxygen environment and cooked at low temperatures. The net effect is precise control over heat, oxygen, and added water, which are the three elements most responsible for reducing the nutritional content of conventionally prepared foods.

As a flameless, low heat cooking method, little additional fat is required during cooking to prevent adhesion of proteins to cooking surfaces. Any added lipids are strictly for the enhancement of mouth feel and flavor. Because of the plastic barrier, oxidation is significantly reduced, preserving the qualities of essential polyunsaturated fatty acids².

The plastic film also prevents the loss of moisture and flavors. Consequently, flavors are amplified, and fewer spices and less salt is required, lowering the overall sodium content of *sous vide* foods. Water soluble minerals are typically leached into cooking water³,

² Sasson, L. (2006). Functions of Fat Lecture, New York University.

³ British-Nutrition-Foundation (1987). "Food Processing - A Nutritional Perspective." Briefing Paper 11: 38.

reducing the mineral content of foods processed by traditional means. The pouch eliminates mineral loss, preserving the mineral content of fresh foods⁴.



Zucchini prepared sous vide

Regardless of cooking process, many vitamins destabilize during heat treatment.

Vitamins most sensitive to heat include thiamin (vitamin B₁), riboflavin (vitamin B₂), and ascorbic acid (vitamin C). Vitamin C is often used to approximate vitamin retention

⁴ Creed, P. G. (1998). Sensory and nutritional aspects of sous vide processed foods. Sous vide and cook-chill processing for the food industry. S. Ghazala. Gaithersburg, MD, Aspen Publishers: 57-88.

because it is relatively easy to quantify, and it decays at a rate similar to many other vitamins. Research indicates that vitamin C retention decreases to 85% after pasteurization and chilled storage for 5 days versus raw product of the same age⁵. Between different cooking methods, *sous vide* provides the highest retention of vitamins versus steaming and boiling⁶.

As with all foods, freshness and minimal processing intervals greatly affect the nutritional profile. Restaurant menu items prepared using *sous vide* highlight fresh textures and lively flavours, making healthful food more interesting to consume. Because dishes are richer in taste, *sous vide* cooking appeals to the American palate, while still maintaining valuable nutritional properties of fresh, wholesome foods.

⁵ Buckley, C. (1987). "Storage stability of vitamin C in a simulated sous vide process." Hotel and Catering Research Centre Laboratory Report 238: 2.

⁶ Petersen, M. A. (1993). "Influence of sous vide processing, steaming and boiling on vitamin retention and sensory quality in broccoli florets." Zeitschrift fur Lebensmittel Untersuchung und Forschung **197**(4): 375-380.

Dangers of *sous vide* in an unregulated environment

Bacteria exist around and within us. As one of the world's most ubiquitous life forms⁷, it is virtually impossible to avoid, especially in a commercial kitchen environment. It is important to note that there are good microbes and bad microbes. Good bacteria are vital to proper digestion, and provide many of the pleasant flavors and smells in food, such as in cheese and bread. Bad bacteria are associated with spoilage and often have a rotting odor.

A good chef normally always smells a product before cooking to ensure freshness. When cooking in a sealed plastic sachet, it is impossible to detect good or bad smells. Contrary to popular belief, vacuum packaging does not inhibit the growth of all bacteria⁸. The anaerobic conditions, together with the relatively low temperature heat treatment of *sous vide* cooking creates an atmosphere in which the most deadly food-borne pathogen, *Clostridium botulinum*, thrives.

⁷ Wikipedia (2006). Bacteria, <http://en.wikipedia.org/wiki/Bacteria>.

⁸ Bowen, D. (2006). Chefs Wait for Rules on Sous Vide, as Experts Question Some Uses. The New York Times. New York: F3.



C. botulinum

Clostridium botulinum is a rod-shaped organism which is commonly found in soil, including farms which produce products for human consumption. It produces spores which remain dormant until they are placed in a low-oxygen environment. Under ideal conditions, *C. botulinum* produces *botulin*, a substance so toxic that less than 1 microgram can kill a healthy person⁹ by paralyzing all the muscles in the body, including the heart.

It is imperative to carefully monitor, document, and control the preparation and packaging conditions within the kitchen. If improperly handled, the following conditions¹⁰ can exacerbate normal bacterial growth and spoilage:

⁹ Wikipedia (2006). "Clostridium botulinum." http://en.wikipedia.org/wiki/Clostridium_botulinum.

¹⁰ Ghazala, S. and R. Trenholm (1998). Concepts in sous vide and cook-chill products. Sous vide and cook-chill processing for the Food Industry. S. Ghazala. Gaithersburg, MD, Aspen Publishers: 295-309.

- *Sous vide* foods lack chemical preservatives, which normally arrest biological activity in processed foods
- Gentle heat treatment only kills vegetative forms of pathogens if the core temperature reaches 60C (140F). It is impossible to monitor core temperature without an invasive probe.
- The reduced oxygen packaging extends the shelf life by retarding aerobic microorganisms, but can facilitate the growth of anaerobic pathogens such as *Clostridium botulinum*, *Clostridium perfringens*, *Bacillus cereus*, and *Listeria monocytogenes*.
- Sufficient cooling must be rigorously applied to prevent bacterial reproduction at all stages of preparation, storage, and regeneration.

While pathogenic contamination is inevitable with all food products, the reduced oxygen packaging used with *sous vide* presents a potentially ideal environment for bacterial reproduction. With rigorous application of proper food handling procedures, the risk of food borne illness may be virtually eliminated. *Sous vide* is a technique which should only be used by trained professionals who can maintain hygienic, precise conditions on a consistent basis.

Addressing food safety issues with proper handling procedures

By identifying critical control points and establishing hurdles to microbial growth, all of the safety concerns related to vacuum packaging and *sous vide* cooking may be virtually eliminated:

- Only the freshest, highest-quality ingredients must be used when preparing *sous vide* packages. This can significantly lower initial microbial levels, extending shelf life and product freshness.
- It is also critical to calibrate equipment on a daily basis and quality-check all seals and packages for leaks.
- Raw packets must not be stored for more than two days before pasteurization above 60C (140F), and must be cooled below 3C (37F) within two hours.
- Pasteurized inventory should be stored below 3C (37F) and consumed or frozen within a specified time period.
- The date and time of packaging, pasteurization, and expiration must be documented and labeled on the package.
- The entire production process must be governed by a Hazards Analysis Critical Control Point (HACCP) system to ensure compliance and corrective actions¹¹.

¹¹ Schellekens, W. and T. Martens (1993). "Sous vide Cooking." Food-Linked Agro-Industrial Research (FLAIR).

The most critical factor in restaurant food handling is temperature control. No other restaurant handling procedure has a greater impact in suppressing bacterial reproduction than ensuring that perishable items, especially proteins, stay out of the ‘danger zone’ of 3C (37F) to 60C (140F). Under ideal conditions, bacterial counts can double every 20 minutes. In a mere 12 hours, a single bacterium may multiply exponentially into a colony of over 9 billion.

Chilled *sous vide* items must be stored within walk-in coolers in covered pans with alternating layers of ice in order to maintain strict temperature control. Walk-ins are typically accessed several times per hour, which can bring the ambient temperature – and everything inside – as high as 14C (57F). Since the *sous vide* bags are packaged and hermetically sealed, there is no certain way of knowing the core temperature of the packaged product unless it is buried in ice at all times.



Measuring the core temperature of a sous vide sachet

Hot *sous vide* items must be monitored with a sterilized temperature probe and a digital thermometer at a sample item's core during pasteurization. The temperature probe is held in place with a 5mm (1/2") adhesive-backed foam strip, applied to the surface of the *sous vide* sachet. This strip must be food-safe; commonly available weather-stripping foam should not be used, as it may contain toxic adhesives.

A conventional bain marie or warming tray must not be used to pasteurize food. Using improper pasteurization equipment can jeopardize safety by failing to evenly heat all packets to the proper temperature. *Sous vide* is a precision cooking technique which requires precise temperature control. This may only be achieved by using an immersion

circulator or stirred precision water bath to minimize thermal gradients, stabilize temperature, and quickly transfer heat into all sachets.

To reduce contamination and discourage bacterial growth, proper procedures must be consistently followed, regularly monitored, and properly documented. *Sous vide* is a technique which, if properly applied, results in wholesome foods with minimum food safety risk.

Following Page: *Sous vide* temperature safety zones:

Assured Pasteurization zone: > 63C +

Start of Pasteurization zone: 60C – 63C

Tolerance zone: 55C – 60C

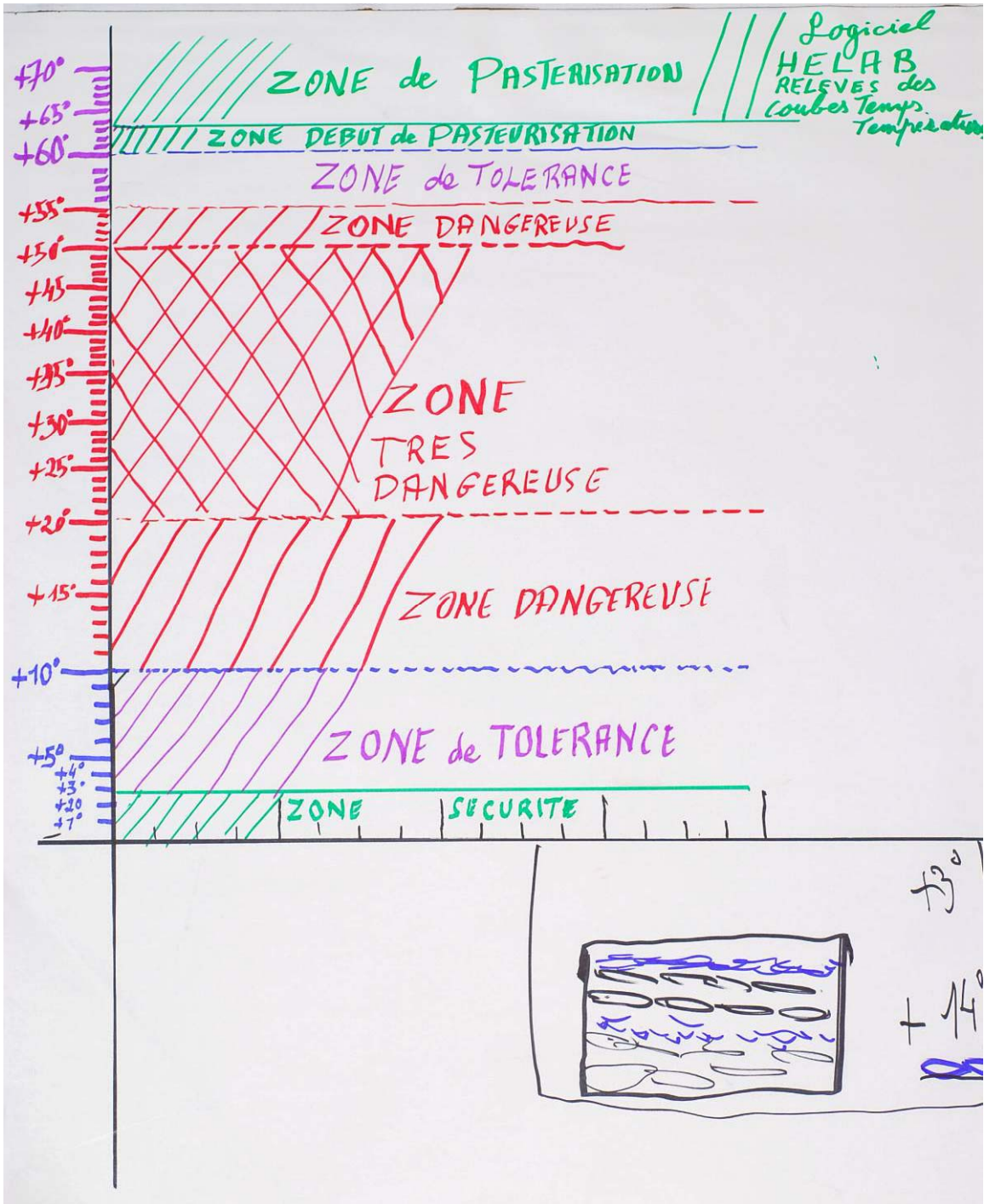
Danger zone: 50C – 55C

Extreme Danger zone: 20c – 50C

Danger zone: 10C – 20C

Tolerance zone: 3C – 10C. most prep takes place in this temp range.

Secure zone: < 3C



Chef Georges Pralus' Temperature Safety Zone Chart

Operational benefits of *sous vide* in restaurants

One of the biggest benefits *sous vide* brings to the restaurant business is operational efficiency. Vacuum packaging inventory and preparing complete single serving meals one or two days in advance can reduce food costs and streamline kitchen operations, especially during the busy service periods. Properly labeled portions are easily retrieved from chilled storage, and may be quickly reheated if more guests appear, or efficiently conserved if fewer guests arrive.

Standardized recipes may be used, enhancing consistency and providing guests with an excellent-quality meal, regardless of line cook skill. Since several meals can be pasteurized or regenerated in the same bath, cleanup is reduced, and fewer pots and pans are used. Fire is eliminated, lowering the kitchen's ambient air temperature and reducing cooling costs.

Conclusion

Sous vide technology is a thoroughly modern application of an ancient, cross-cultural cooking practice- applying long, slow heat to enhance flavors while preserving texture. Industrial food producers have embraced *sous vide* as a safe, effective method of packaging wholesome, minimally processed food with superior sensory characteristics. Restaurants have been slower to adopt the technology, due to the complexity of the technique, a lack of training, and the cost of the equipment.

Fresh *sous vide* handling procedures, mostly used in high-end restaurants, emphasize control over the organoleptic properties of the final product. Pasteurization times are kept relatively short to maintain texture and sensory properties at the expense of long storage intervals.

The hermitically sealed plastic bags form oxygen barriers, which slow the growth of aerobic bacteria, delaying spoilage. While this is certainly a benefit, the downside is that anaerobic bacteria may thrive under the right conditions. Unfortunately, the most deadly food-borne illness, botulism, is carried by anaerobic bacteria. Because of this, foods must be of the highest quality and handled within strictly maintained temperature ranges according to HACCP procedures.

Sous vide cooking brings multiple benefits to restaurants in the form of increased service efficiency and lowered food costs. Preserving inventory in vacuum sealed bags is an excellent way of extending the shelf life of a product, provided proper handling procedures are followed.

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