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An Examination of Modernist Culinary Techniques and Equipment and their Application in Catering Operations

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by

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Part One

Introduction

Culinary arts are constantly evolving. Not all of these evolutions have been embraced by those practicing the profession. Many of the developments proved to be just passing fashion while others moved the industry forward. Modernist cuisine is one of the newer evolutions in the foodservice industry. Many mistake the science of molecular gastronomy, which is a scientifically based approach to understanding the cooking and eating processes (Vega, 2008) with modernist cuisine. Modernist cuisine takes the knowledge gained from this scientific understanding and applies it to food production in a restaurant setting.

Catering is a segment of the foodservice industry that supplies food and beverage to groups of clients either in-house at an established property or off-site at a remote location. As with most foodservice operations, cooking procedures are standardized and based prevailing practices. The menus of the operations may vary but the ingredients used to produce them are universal. Procurement and storage of these ingredients follow standard procedures that are common throughout the industry.

This paper discusses the history, concepts and applications of modernist equipment and technology are discussed with an emphasis on incorporating them into current production practices used in the catering industry.

Purpose

The purpose of this paper is to examine modernist culinary techniques and equipment and their application to a contemporary catering operation.

Statement of objective

The practice of culinary arts in reference to food production is slow to adopt change. This is especially true in a catering operation. The industry uses standard operating procedures that have been passed down from chef to chef through several generations. Most catering operations face the same challenges when producing large quantities of food in a very short time. Many times this is done with limited equipment and staff. In addition, the menus can vary from event to event so that preproduction of product for multiple functions may not be a viable option.

This paper does not look to redesign food production practices that have been in use by caterers for a multitude of years. Nor will it address all operational problems confronted during that production. As an industry, caterers are always faced with decreasing profits because of increases in labor and food costs. This paper reviews the newest equipment and techniques in the industry to illustrate options available to increase the efficiency of the labor and food handling practices.

Justification

The organizational and operational procedures used in the majority of modern foodservice operations were developed over a century ago by Auguste Escoffier. His innovations immediately increased productivity. This paper addresses those operational aspects of food production with the intent to demonstrate how new technological advances will increase efficiency and productivity in modern catering operations. By adopting modern technology, catering operations will be able to produce product that is safer, innovative and cost effective.

Constraints

The research for this paper is limited in scope by the number of different types of catering

operations. The size of the operations and type of production facilities vary from company to company and will limit a full review of all production practices. The skill level and culinary knowledge of each operation will vary. The research will include a comprehensive review of current books, magazines, journal articles and equipment manuals related to modernist cooking however, few of these articles are specific to catering operations but reflect foodservice operations in general.

Part Two

Introduction

Catering is a term used to describe a multifaceted segment of the food service industry. It generally refers to functions that are independent of the everyday operations of an existing food service operation. In catering, each function is treated as an independent event. These types of functions include weddings, corporate parties, birthdays, Bar Mitzvahs and a multitude of other events. This requires advanced planning. Most functions are booked several weeks or months ahead, and require the development of specialty menus that can reflect many different types of cuisine. Labor and cost control functions differ from a standard restaurant operation because much of the labor is hired as they are needed and food is usually ordered specifically for an event.

Catering can fall within any of the three most common segments; commercial, noncommercial, and military. Commercial catering is considered the for profit segment of the industry. This can include on-premise catering, where the function is held within the caterer's own facility. Many hotels and restaurants include specialized kitchens and banquet rooms to cater to these private parties. A second type of for-profit catering is off-premise catering. This requires the caterer to prepare all foodstuffs in a commercial kitchen then transport the food, and possibly a mobile kitchen, to a location other than the building it was prepared in. This can include parks, beaches, office buildings, private homes and such. The caterer may also be asked to provide all of the tables, chairs, decorations and anything else required for the function (Jardine, Mills & Shiring, 2001, p. 3).

Noncommercial catering, also known as contract catering, includes foodservice for

hospitals, schools, prisons and many corporate facilities. The military segment caters to military bases and works both on and off site operations; this segment also includes feeding our soldiers in the field (Jardin et. al., 2001). While the application of modernist techniques can benefit any type of operation, this project will be looking at the commercial segment of catering.

Catering operations in the United States are on the rebound. Revenues exceeded $14 billion in 2010. This was a 9% increase over 2009. Sales are expected to increase 9% in 2011 and 7% in 2012 (Packaged Facts, 2011). This includes independent and hotel, restaurant and contract catering operations. The independent catering industry includes about 10,000 companies with combined revenue of $5 billion. The industry is highly fragmented: with the top 50 companies accounting for less than 15 % of industry revenue.

The demand for catering is driven by corporate profits and consumer income. The profitability of each company is dependent upon cost controls and effective marketing. Large companies have an advantage in offering expanded services such as facilities management, room rental, and entertainment. Small companies can compete by serving smaller groups and offering personalized service. For both large and small companies the industry is labor intensive with the annual cost per worker around $40,000 (M2pressWire, 2010). While revenues are increasing so are the costs of foodstuffs and labor thus affecting the profitability of each catering operation. Introducing new methods to an organization can increase efficiency in food handling and labor, and therefore profitability.

Brief History of Catering

The history of catering worldwide covers the provision of food and accommodations for the traveler. In the early times people traveled for business, usually for the governments or the

kings, or on pilgrimages to holy shrines such as Mecca. The first providers of food and shelters were in the Middle East along the caravan routes. Thus, roads were an important development for the early catering operations. In medieval Europe Posting houses, similar to a tavern, offered food, rooms and a change of horses. Monasteries and castles offered hospitality to travelers, and monks brewed good beer and served hearty meals. By the middle of the sixteenth century the hospitality offered by the monasteries and castles was in decline. This was due partly to Henry VIII dissolving the monasteries and, by royal edict; inns were classified and licensed (Cracknell, Kaufmall & Nobis, 2002).

From this first venture into hospitality, there are now major hotel operations such as Hilton, Intercontinental, and Holiday Inn operating around the world. The development of the hotel industry naturally lead to the rise of restaurant operations and from restaurants operations there was a need for both in-house and off- premise catering. As people's disposable income has risen, so has their ability to spend money in leisure pursuits, this includes meals away from home and private events including throwing a good party once in a while (Cracknell et al., 2002).

Common Food Production Methodology

Purchasing and Storage

Food is handled many times between the time it is received by a company and when it is served. Generally it is necessary to control receiving and storage to prevent contamination of foods and to prevent the growth of bacteria that may already be in the food. Dry goods are stored in a cool, dry place, off the floor and away from walls. Frozen foods are kept at 0°F or lower. They are tightly wrapped to prevent freezer burn (Gisslen, 2011). Refrigerated foods are kept at various temperatures (see Table 1).

Table 1

Food Storage Temperatures

Product	Temperature
Raw vegetables and fruits	40° -45°F
Eggs	38°-40°F
Milk and cream	36°-40°F
Poultry and meat	32°-36°F
Fish and seafood	30°-34°F

Note: Adapted from "Professional Cooking" by Wayne Gisslen, 2011, p. 28. Copyright 2011 by, John Wiley and Sons, Inc.

Although sanitation is an important concern, so is the loss of product quality due to improper handling. This is a major cost factor in catering, with food spoilage and waste accounting for 2-3% of costs and therefore lower profits. (Cracknell, H.L., et al., 2002)

Production

Food production throughout the industry varies from operation to operation, however it is possible to look at several standard operating procedures used in the majority of the foodservice industry. Cooking procedures are divided into two different methods, moist heat cooking and dry heat cooking. These are differentiated by the way that heat is conducted to the food. In moist heat cooking, heat is transferred by the use of a liquid such as water, steam or stock. In dry heat cooking, heat is conducted without the use of moisture; this includes hot air, metal, radiation or hot fat. The different methods are suited to different kinds of food (Gisslen, 2011).

Moist Heat Cooking Methods

These methods include poaching, simmering and boiling. The differences between these

methods are the temperatures of the liquids involved in the heat transfer. In boiling the temperature is around 212°F at sea level. Boiling is generally reserved for vegetables and starches. The use of higher temperatures during cooking toughens the proteins of meat, fish, and eggs, and the rapid bubbling breaks up delicate foods. Simmering involves cooking at temperatures of 185°F to 205°F. This is a gentler method without the agitation of boiling, however submerging products in liquid to cook will allow for the loss of flavor and nutrients. Steaming is cooking foods by exposing them directly to steam. In quantity cooking most steaming is done in specialty steamers, usually pressure steamers. These hold food in a steam chamber that is under pressure. This allows the temperature of the steam to go above 212°F and cooks the food rapidly. Steaming and pressure steaming are both considered the best way to prepare vegetables because it minimizes the loss of nutrients (Gisslen, 2011).

Braising is considered to be another method of moist heat cooking but it is actually a combination cooking method. Braising involves cooking with the pan covered, with a small amount of liquid in the pan, and is usually done after preliminary browning of the product. Some refer to it as stewing. Braising is used for large cuts of meat while stewing is for smaller cuts. Both methods follow the same procedure of browning the meat then cooking it with moist heat. Braising is used for both meat and vegetables with items such as pot roast or braised cabbage (Gisslen, 2011).

Dry Heat Cooking Methods

These methods encompass many different techniques. These include roasting, broiling, grilling, sautéing, and deep frying. Dry heat methods have one thing in common, food is always cooked uncovered. This prevents the retention of steam and allows the food to brown, creating a

distinct flavor. This process is usually reserved for meats that are tender as there is no mechanism to create tenderness in the method. Vegetables develop a very sweet flavor when cooked with dry heat as they allow for the caramelization of the sugars within the vegetable itself. Roasting is done in an oven with the food generally placed in a pan on top of a rack. This allows the food to be surrounded by hot dry air. Broiling, on the other hand, means to cook with radiant heat from above. This is a very rapid, high-heat cooking method. This type of cooking is common in large steak house operations such as Ruth's Chris. Sautéing is to cook quickly, on high heat, in a small amount of fat; it is reserved for smaller pieces of food. Pan frying is similar to sautéing, except that it requires a greater amount of fat and lower heat setting. Pan frying is used to cook larger pieces. Both methods allow the food to brown and create flavor. Deep-frying is cooking by submerging food in hot fat. Many foods are deep-fried such as French fries and battered fish. Many people are moving away from eating foods cooked by manor because of health concerns (Gisslen, 2011).

Modernist Cuisine

Modernist cuisine is the newest buzz word used to describe a style of cooking that has become popular in many fine dining restaurants around the world. It has taken the food industry to new places by using ingredients and devices usually only found in mass food production facilities and has moved them into the restaurant kitchen (Vega & Ubbink, 2008). This has not been embraced by the entire culinary industry. According to Adrià, Blumenthal, Keller, and McGee (2006, p 31), "this is a turning point in the history of cooking [and probably food itself] that has been widely misunderstood, both outside and inside our profession(s)". They are talking about the phenomenon known as "molecular gastronomy" from which much of the inspiration

for modernist cooking is derived. Many think of molecular gastronomy as a cooking style but actually, it is a scientifically oriented approach towards understanding the basic mechanisms occurring during the cooking process (Vega & Ubbink, 2008). The term molecular gastronomy has created a lot of confusion in the media and this confusion has permeated the culinary industry in general. This is because of mistakes, explained later in this paper, made by Hervé This, the Director of the Foundation Science and Culture Alimentaire in Paris, and the late Nicholas Kurti, a professor of physics at Oxford University when they were developing the discipline in 1988 (This, 2006a).

Beginnings of Molecular Gastronomy

It is important to distinguish between cooking and gastronomy: the first is the preparation of food and the latter is the knowledge of whatever concerns man's nourishment. This discipline does not involve food fashion or how to prepare a certain dish but rather an understanding of food. Molecular gastronomy in particular, is the chemistry and physics behind the preparation of the dish. An example of this would include looking at why mayonnaise gets thick or why a soufflé swells. While molecular gastronomy is a relatively new science, the science of food is not. In the second century BC, an anonymous author of a papyrus scroll, (currently in the London Museum) used a balance scale to determine whether fermented meat was lighter than fresh meat. Since then, scientists have been interested in food and cooking. In the eighteenth century, Antoine-Laurent de Lavoisier, at the time a very famous chemist, showed an interest in food preparation when he measured the density of meat stock to evaluate its quality (This, 2006a).

Throughout history, discoveries by scientists have moved food production forward. In

the 1980s, food science was mainly concerned with analyzing the content and properties of food and how these properties related to the demands of our bodies. This information was used to help develop methods to process foods on an industrial scale. However, millions of people who cooked for themselves and their families had no scientific knowledge to help them understand what was happening during the cooking process. There is a vast difference between understanding the science of ingredients and the science of culinary processes. The techniques used in culinary books from the fourteenth century to the twenty-first century all look the same, despite the introduction of new recipes. Cooking was the last of the "chemical arts" to become the object of scientific study. It still relies on anecdotal knowledge rather than solid science. As recently as 2001, in a public lecture, an inspector from the French Department of Public Education stated that her mayonnaise failed while she was menstruating. Such old wives' tales were partly the reason that led to Dr. This and Dr. Kurti's decision to develop the science of molecular gastronomy (This, 2006a).

Modern Movement

Initially molecular gastronomy had five aims; (i) to collect and investigate old wives' tales about cooking; (ii) to model and scrutinize existing recipes; (iii) to introduce new tools, products and methods to cooking; (iv)to invent new dishes using knowledge from the previous three aims; and (v) to use the appeal of food to promote science (This, 2006a). This is where the problem lies, as objectives (iii) and (iv) are technological not scientific, and (v) is political. It is because of these flaws and the lack of understanding by the general public that there has been so much confusion. According to Dr. This, " a dish is considered good when it is technically successful (a failed mayonnaise is a failure), when a flavor pleases the customer it is considered

art and if a dish is not brusquely thrown at a customer it is considered love. This means that science should investigate all three of these components, art, love and the technical component but only from the scientific point of view, hence the confusion" (This, 2006c, p. 49).

When molecular gastronomy was first introduced to the public, the discipline attracted a significant amount of media attention. This attention was neither always positive nor accurate. While many chefs in the European culinary community embraced the new knowledge and approach to cooking, many other chefs did not and in fact, many saw it as an affront to tradition. This reaction to the current culinary revolution is similar to that received by the last important culinary revolution in the 1970's. That was known as nouvelle cuisine. The cooking style transformed classic French cooking by making it lighter, fresher, and broader with Asian influences and more appealing plating presentations. Interestingly, to the general public, and food scientists alike, nouvelle cuisine was been reduced to merely smaller portions and beautiful presentations. This idea prevails even today. It is believed that the misconception is a consequence of poor communication on the part of the culinary trade at the time of nouvelle cuisine's development and a lack of interest from the final consumer in the real meaning of food (This, 2006a).

There is a growing awareness amongst chefs of the physical and chemical processes occurring during cooking and an increased emphasis on eating as an innovative, intellectual, and sensory experience. For some, this has led to the adoption of ingredients and techniques originally developed for industrial food production. However, the term molecular gastronomy is shunned. Several different names have been adopted to describe this style of cooking. They include avant-garde cuisine, techno-emotional cuisine, van guard cuisine and modernist cuisine

(Vega & Ubbink, 2008).

Modernist Cuisine

Cooking is considered an art, hence culinary arts. It is not always easy to determine the origin of an artistic movement, such as modernist cuisine. Although it can trace its roots back to molecular gastronomy we can focus on four individuals who are precursors to the revolution. In the mid 1980's Ferran Adrià began creating new intellectually motivated cuisine at El Bulli in Spain. Herald McGee, later joined by Hervé This and others, started a trend towards the appreciation of the scientific basis for cooking. Heston Blumethal, owner of Fat Duck in England earned three Michelin stars while using modernist methods and would be proclaimed by many food critics as having the best restaurant in the world. These four people each contributed to the creation which is called the Modernist revolution (Myhrvold, Young & Bilet, 2011a).

By the year 2000, the Modernist culinary movement was well underway and a new generation of chefs had joined the revolution. These included Thomas Keller of the French Laundry, Grant Achatz of Alinea, Wylie Dufresne of wd-50, and many other young chefs around the world. Modernist dishes have taken on many forms, reflecting the diversity among their creators. Many may seem eccentric to the average person but surprise, drama, humor, and even misdirection are part of what makes this cooking style so unique. These include such dishes as: nitro scrambled eggs; bacon ice cream; carrot air with mandarin and bitter coconut milk; and red mullet mummy with sea water cotton candy.

It was into this group of culinary innovators that an unlikely collaborator emerged, surprisingly he is not a chef. His name is Nathan Myhrvold. He developed the software company that eventually became Microsoft. While working for Bill Gates in the late eighties, he

developed an interest in cooking. By the mid-1990s he decided to take a leave of absence from Microsoft and attend Ècole de la Varenne in Paris. For two years he worked in many restaurants in Europe and the United States. Eventually he left Microsoft to spend more time focused on developing modern cooking techniques. This led to what is considered to be the bible of the modernist revolution, a six volume series of books encapsulating the techniques of both the science and the art of cooking titled Modernist Cuisine (Myhrvold, et al., 2011a).

Modernist Cuisine Practices

Cooling/Freezing

The advent of refrigeration made modern food service possible. Before refrigeration food vendors had to transform food dramatically in order to preserve it by using techniques such as brining, pickling, salting, smoking or drying. During the Napoleonic era the innovation of canning was developed. This allowed foods to be preserved longer but these treatments increased cost and limited flavor. The food may have tasted delicious but it certainly didn't taste fresh. **(**Myhrvold, Young & Bilet, 2011b).

Refrigeration and particularly freezing has allowed caterers to improve the quality of their dishes while lowering cost at the same time. With the development of chilling and freezing technologies, ingredients can be procured in advance when the prices are low or when the product is in season. Then, with proper preparation, they will maintain a fresh texture and flavor. This also allows a caterer to "preload" labor into products that can be used at a future date. Staff members that are "on the clock" during a slow period of production can use that time to prepare and freeze food for future use. This allows the company to store labor and cut costs on upcoming events.

With all the advantages of modern technology there are still problems of food preservation to be solved. Refrigeration slows bacterial growth, enzymatic and other chemical changes that effect food quality, freezing halts bacterial growth and prevents reactions among waterborne components but neither halts oxidation of lipids nor other fatty substances that leads to rancidity. Wrapping food heavily in plastic or placing them in tightly covered containers only slows the process slightly. Sous vide techniques, which will be discussed later, have been incorporated into the chilling and freezing process to allow for fresher flavor retention by eliminating nearly all the oxygen from the storage environment. The sealed bag act like a second skin to halt the evaporation of the flavor compounds and helps prevent oxidation which leads to rancidity (Myhrvold et al., 2011b).

Although freezing greatly extends shelf life, it sometimes comes with a loss of quality. The growth of ice crystals damages texture and causes the loss of juices and the aromatic components that create flavor continue to evaporate even from food that is frozen. Ice crystals grow in frozen food regardless of how they are packaged. It is this process that damages flavor, texture, and appearance of food that has been frozen. Much of the damage is dependent on how fast the crystals were formed. Crystals begin to form in water outside the cells at a temperature of about 30°F. Water inside these cells begins freezing around 14°F. Once all the water outside the cell is frozen, the water inside the cell will remain liquid. This creates a problem. Even though most commercial freezers operate at -4°, a significant portion of the water in the cell remains liquid because the frozen water outside the cell acts like an insulator and prevents freezing. In this scenario, ice crystals continue to grow larger day by day. They feed their expansion with water drawn from that which is still in a liquid state. Many of the cells are left

dried out and ruptured and riddled with large ice crystals that continue to grow and further damage the texture. When the food is thawed the juices flow out through these ruptures. When food is frozen at an extremely low temperature, which is lower than that of a standard commercial freezer, any remaining liquid water within the cells turn so viscous that it become a glass, a solid in which the molecules sit in random order rather than in rows as in a crystal. This is known as the foods glass-transition temperature. When food is frozen quickly it moves through the glass transition phase and does not allow for the formation of large ice crystals thus helping to retain quality (Myhrvold et al., 2011b).

This quick chilling/freezing can be obtained with several types of commercial equipment or processes. Many are not cost effective for the average caterer. The most common method for quick chilling and freezing used by food service operations is known as blast freezing. This requires the use if s type of freezer known as a blast freezer. It includes a fan to increase air flow around the food and very low temperatures to speed up the freezing process. It can freeze food in a half hour or less thus helping prevent the formation of ice crystals.

Most of the modern blast chillers are set up with four cycles that have been designed to lower the temperature of foods that have just been cooked and are still hot, or it can be used to freeze raw products that are for use at a future date. Again, this allows a caterer to purchase products when they are in season or are on sale and hold them for use at a later date without a significant loss in quality (see Table 2).

Table 2

Standard Blast Freezer Cycles

Cycle	Results
37°F Delicate	Temperature of product quickly reduced at core to 37°F with a work temperature of 32° Used for delicate products such as: • Mousse • Desserts • Vegetables • Foodstuffs with reduced thickness
37°F Strong	Temperature of product quickly reduced at core to 37°F with a work temperature between 5°F and 36°F Used for the following products: • High fat content • Very dense • Large pieces • Packaged
0°F Delicate	Two freezing phases Phase 1, temperature of product quickly reduced to 43°F with a work temperature of 37°F Phase 2, temperature reduced at core to -0,4°F with a work temperature of -40F° Used for all cooked foods
0°F Strong	Temperature of product quickly reduced at core to -0,4°F with a work temperature of -40°F Used for all raw foods and for cooked foodstuffs with a greater thickness

Note: Adapted from "Use and Maintenance Instructions, Multi Fresh" by Irinox

The use of liquid nitrogen is a relatively new technique in culinary arts. Liquid nitrogen is at a temperature of -320°F and has been mainly used for industrial purposes. Many modernist kitchens use it for the production of small batches of ice cream or sorbet. This produces a very

creamy and smooth texture due to the short freezing time and the lack of the development of ice crystals (Ivanovic, 2011). It can be used for quick freezing of expensive items such as foie gras, fattened duck or goose liver. Traditionally, foie gras was refrigerated rather than frozen. This is not ideal as the liver is full of enzymes which degrade rapidly and create an off flavor and grainy texture. The freezing process is as simple as just immersing slices of foie gras into the liquid nitrogen which is being held in an insulated container such as a Styrofoam chest or an open dewar, the insulated metal containers designed specifically for use with liquid nitrogen.

Because liquid nitrogen is transparent, you can see the process to know when the item is frozen through. As long as bubbles are still forming on the outside of the food, it is not frozen. When the bubbles stop, the product is frozen. Freezing with liquid nitrogen is not recommended for thick items but mainly for small or thin pieces that can freeze inside and out at the same time. The use of liquid nitrogen does present some problems. The interior of the product expands during the freezing process while the exterior is already frozen and causes freeze-cracking. Usually foie gras is cooked as thin slices anyway so cutting it is not a major variation in how it is to be used. It is also not recommended for food in sous vide packaging as the plastic bags become brittle and crack thus compromising the safety and quality of the food (Myhrvold, et al., 2011b).

Lastly, an inexpensive yet effective way to freeze vacuum packed foods quickly is in an ice-brine bath. The salt in the brine lowers the freezing point of water. Ice floating in brine at 23% salinity will reach the temperature of -6°F. This is cold enough to freeze most of the water in food. Liquid water is a very good thermal conductor so it draws the heat from the food quickly and evenly (Myhrvold et al., 2011b)

Reduced Oxygen Packaging

Reduced oxygen packaging has been used for quantity food production for a long time. One only has to look in the refrigerated cases or shelves of any local super market to find foods packaged this way. Use of reduced oxygen packaging is often associated with cooking in a low temperature water bath known as sous vide. It has also become useful for storage of foods commonly used in catering including dry goods, proteins and fruits and vegetables.

The aim of storing food is to have it on hand for production while slowing down their natural deterioration and maintaining their quality for as long as possible. The enemies of freshness are heat, light and air and at times moisture. By keeping foods in cold, dark, airtight conditions it will achieve a longer shelf life. Refrigerating or freezing food will increase the storage life by removing heat energy from it. This slows down the chemical changes that cause spoilage and food-related illness (McGee, 2010).

Chef Thomas Keller of The French Laundry, per se, Ad Hoc and Bouchon has adopted vacuum packaging for many storage and culinary uses in all of his restaurants. He has found that he can prevent oxidation by using vacuum packaging on apples, pears, artichokes and foie gras. He also uses it to help prevent freezer burn on products that must be held for longer periods of time. Dry goods can also be held under vacuum to prevent oxidation. Chef Keller notes that there are safety issues of concern in storing food under vacuum that differ slightly than those that cooks are used to addressing when using more conventional storage methods. As a general rule, it is necessary to treat all food that is sealed in a bag as though it carries harmful bacteria. Food to be stored in a vacuum bag needs to be thoroughly chilled before it is sealed and then refrigerated or frozen immediately (Keller, 2008).

In order to use any vacuum packaging for food storage or cooking, most state health departments require that restaurants adapt a HAACP plan. The HAACP method originated with the National Aeronautics and Space Administration (NASA). A hazard–assessment protocol was required for General Mills when they began producing foods for the astronauts to insure that the foods were safe to consume. HACCP is about planning and documenting food production in a very detailed way (Myhrvold, et al., 2011b). It's comprised of the following principles:

1. Conduct a hazard analysis. Review each step in food preparation and the cooking processes to identify where and when the food safety hazards might appear.
2. Find critical control points. These are the steps in the production process during which problems such as unsafe temperatures or contamination could occur.
3. Create critical safety limits. Establish a limit, such as a temperature or time minimum, a time-and-temperature combination, or a use–by date, for each critical control point in the production process.
4. Set critical control point monitoring procedures. Make a plan to insure that the critical control point stays within the safety limits.
5. Define corrective action. These rules spell out what to do when a critical control point limit is not met.
6. Keep records. Record-keeping should encompass all aspects of the HACCP plan: the control points, their limits, monitoring procedures, and corrective actions.
7. Validate. Devise a way to measure end points or results that show the HACCP system is working as planned.

Sous Vide or Precision Temperature Cooking

Sous vide (cooking food placed in a vacuum bag) or precision temperature cooking (cooking wrapped food in a low temperature water bath) is a relatively new form of cooking but the fundamental principles are ancient. Most cultures have traditional dishes in which food is wrapped and cooked at low temperatures for a long period of time. Lambs or pigs are buried in the sand or earth and slow cooked, foods are wrapped in banana leaves and steamed, and other items are cooked in tightly covered clay pots for hours.

Sous vide cooking has been used in commercial food production for many years. Vacuum-packing of food began with Hills Brothers coffee company in the early twentieth century. In the 1940s, a company called Cryovac used plastic to shrink-wrap turkey for freezing. This turned what was a seasonal food to a year-round staple. In the 1960s, hams and sausages were being vacuum-packed for preservation and later cooked which, in essence, pasteurized the food and helped eliminate bacteria that caused spoilage.

The process has only recently reached restaurant and catering kitchens. It began in the 1970s when a French biochemist, Bruno Goussault, working for a chain of restaurants, realized that you can make an inexpensive, tough cut of meat tender by cooking it in a vacuum sealed bag. This is done in a water bath, in the oven at a very low temperature. He later traveled to a hospital that was cooking food, wrapped in plastic, at 185°F in order to pasteurize it. He compared cooking at high pasteurization temperatures and low temperatures and found that lower temperatures resulted in better foods. In 1974 he presented a paper outlining the favorable results of low temperature cooking (Keller, 2008).

That same year, in Roanne France, a Michelin three star chef Jean Troisgros, was trying

to improve his cost on foie gras. He approached a local butcher and sausage maker, Georges Pralus for help. Pralus found that by wrapping the liver in several layers of plastic wrap and cooking it in hot, not boiling water, it retained more fat than when cooked conventionally. This was the beginning of sous vide cooking in fine dining kitchens (Keller, 2008).

Modern chefs have embraced sous vide and precision temperature cooking because of the unparalleled control it provides over the flavor and texture of food. Foods can be heated to a precise temperature to insure perfect doneness so every region within the food reaches the same temperature, thus eliminating over cooking. This type of cooking is especially useful for meats and seafood for which small variances in temperature affect the finished product. It also ensures food will be noticeably juicier, tender and more flavorful. Portions can be cut in advance, weighed, labeled, and seasoned then held for later cooking either fresh or frozen.

Using this method also requires minimal equipment. The most expensive being an immersion circulator. This machine heats a water bath to a specific temperature and maintains it indefinitely +/-1°. They are small and portable and any insulated container can be used to create the water bath. The sous vide process uses foods that have been vacuumed sealed using reduced oxygen packaging equipment, however it is possible to simply wrap the food tightly in plastic wrap or to use sealed bags commonly known as “Zip Lock” bags, this is known as precision temperature cooking (Myhrvold,et al., 2011b).

Combi Oven Technology

In 1976 a company in Germany, later known as Rational AG, invented an appliance known as a combi-oven. It was so named because it cooks with ambient circulating air as an ordinary convection oven does, cooks with injected steam, or does both in combination. The

importance of keeping food humidified while it is heating has been long understood. This is why it is common to cover food while cooking, wrap baked potatoes in foil, roast in bags, or baste.

These advanced ovens have proved to be very useful kitchen tools. They can be used for proofing baked goods, thawing, holding, roasting, baking, steaming, poaching and "oven frying." These ovens transfer heat more readily, due to the moisture in the air, than do ovens using dry air heat alone. Moist air also smooth's out temperature swings in the food and helps minimize hot and cold spots.

These ovens operate in different modes that create different results. Low- temperature steam mode cooks food with air that has been saturated with 100% humidity. Low temperature means heat levels are below the boiling point of water 212°F (at sea level). This creates the same type of cooking environment as that found in a sous vide bag or a covered pot. In steam mode the humidity is at 100% but the temperature is held at the boiling point (212°F). This is no different than steaming in a pot but is a lot more convenient and can handle larger quantity of foods. They also have a combination mode that allows food to be cooked at a specific temperature and humidity then temperature can be increased to allow browning (Myhrvold et al., 2011b).

These ovens allow for presetting of a roasting temperature then adding holding temperatures to allow for overnight cooking. They are both labor and energy saving. Roasting in a conventional oven creates a weight loss in roasting meat is as high as 30%, whereas in a combi-oven weight loss is only 18%. Different foods can be cooked at the same time without any cross-flavor problems. Many foods can be cooked in advance and then reheated at service without drying out (Cracknell, et al., 2002).

Conclusion

Catering encompasses a large segment of the foodservice industry. It has a history extending back to ancient times. It is possible to examine traditional cooking methods and see that they also have very old roots. They are utilized in catering kitchens throughout the world, are acceptable for production, and can produce exceptional results in the hands of a talented staff. But as with any industry, change can be difficult to implement. Innovations in culinary arts are especially difficult to adopt as the traditions of cooking look to the past for direction.

Modernist cuisine is not as new as it seems. It also has ancient roots in scientific inquiries of the second century B.C., through the discoveries of Dr. This and his development of molecular gastronomy. The modernist movement had many trendsetters that continue today moving the methods and techniques forward. These methods and techniques incorporate new equipment to perform tasks common to most kitchens. The difference lies in the efficiency of the modern technology and its ability to perform multiple functions. Some techniques such as sous vide seem strange but again, are based in traditional practices.

Cooking is an ancient art. As with any art, it is constantly evolving. The catering business is no different than any foodservice operation. They are all tied to the practices and procedures that have been passed from generation to generation. Equally, they are slow to embrace change. By examining the newest techniques and technology available, caterers will be able to move forward and stay competitive.

Part Three

Introduction

Operating a catering company can be very lucrative; however it also requires hard work, long hours, strong planning and organizational skills, and the ability to work in an efficient manner. Most caterers have a background in foodservice or hire someone that comes from the foodservice industry to oversee the daily operations. Most have been trained in conventional cooking and food handling processes that have been used for many years and continue to use them today.

Food travels along many paths from the time it enters the foodservice operation until it is presented to the guest. Physical, chemical, and microbiological changes occur in food throughout all stages of procurement, production and service. It is necessary to control these changes to ensure quality and safety of the finished product. In addition, faced with both increasing labor and food costs and a shortage of highly skilled employees, caterers are looking to using new forms of foods with built in convenience or labor-saving features. New food products, available in various forms and stages of preparation have become available in increasing numbers each year (Gregoire & Spears, 2007). Even though convenience foods are available, many caterers still prefer to cook from scratch. It is these traditional production methods that can be transformed to modernist cooking methods that will make the company more efficient and profitable.

Catering menus vary from company to company but many of the items are similar in ingredients and may differ only in presentation. The following items have been culled from several catering menus currently in use in the Las Vegas valley. An examination of modernist

cuisine applications to some of these universal ingredients follows.

Table 3

Catering Menu Items

Appetizers	Entrées & Vegetables
Seared Ahi (tuna)	Lemon Chicken
Caviar Deviled Eggs	Beef Stroganoff
Roast Beef Roulade	Roasted Kahlua Pork
Grilled Salmon Medallions	Short Ribs
Jumbo Shrimp	Prime Rib
Chicken Cashew Salad	New York Steak
Smoked Cranberry Chicken	Sweet and Sour Pork
Raspberry Chipotle Meatballs	Sautéed Spinach
Chicken Wings	Steamed Asparagus
Fruit Trays	Potatoes

Note: Adapted from menus for "Affairs to Remember", "Las Vegas Catering", "The Chefs Catering"

Purchasing and Storage

Storing food safely is no less important than buying, receiving or preparing the product. Storage practices vary from operation to operation but they are critical to the freshness and quality of the final product. Storage facilities and space available are always significant and usually inadequate. An operations walk-in refrigerator and freezers are essential to safe food storage. By utilizing new storage techniques some of the problems can be addressed (Riell, 2003).

In a catering operation most foods necessary for an event are ordered as close to the date of service as possible. This is to insure the quality and freshness of the product. Standard procedure for the majority of food service companies when receiving product would be to inspect deliveries as they arrive and choose the proper storage method appropriate for the product. Products such as meat, poultry, and fish are ordered for use on an as needed basis. This does not allow the caterer to take advantage of price fluctuations that occur naturally in the marketplace. In the above menu, it would be typical to receive the Ahi tuna and salmon within one to two days of service. Many times specialized quality product is not always available due to weather conditions, truck breakdowns, or any number of other problems. These fish can be ordered well in advance, cut to portion sizes specific to many different recipes then frozen in a blast freezer. If they are then packaged in vacuum bags, they can be held frozen for more than six months without any loss of quality. This method can be used for any of the protein items on the menu. It is especially suited to items that can be bought in larger pieces such as a New York strip loin which can then be cut into portion sized steaks and frozen. It is possible to buy larger pork or beef cuts used to produce the sweet and sour pork or beef stroganoff, then cut and package them per the recipe specifications. This saves time during production and does not require the cook to have meat cutting skills.

Blast Chilling/Freezing

Cook-chill systems are easy to use, cost effective, and are suitable for operations of all sizes. It is a comprehensive system of food preparation, packaging, chilling, and storage. It works by cooking food to a "just done" state, then utilizing a blast freezer to chill the food quickly (down to 37F in less than 90 minutes) and storing it under tightly controlled conditions

("Cool-chill systems," 2010). According to Stuart Ferguson (2008) cook-chill offers caterers the flexibility to produce hundreds of meals in less than 15 minutes. The food is prepared well in advance of service, quick-chilled and stored then re-heated near service and plated at your leisure in as little as 8 minutes. Many of the new combi-ovens are equipped with programs that allow different chilled foods to be heated at the same time. This is especially useful to a caterer because the timing of service is at the discretion of the guest. Service times at weddings and events with speakers are often changed at the last minute. This system takes the pressure off of the staff by allowing them to serve at any time without the worry of having to hold the food and possibly overcooking it or not having it ready if the guest wants to eat early. These systems are shown to cut food costs by limiting food shrinkage and cut labor cost by allowing three cooks to produce an event for 200 guests that used to required eight cooks (Ferguson, 2008).

Utilizing a blast freezer makes it possible to purchase protein products when prices are low due to market conditions or if large quantity discounts are available. This also allows for the caterer to utilize labor in a more efficient manner by having skilled cooks cut and portion the products in large batches then less skilled workers can just pull out what they need and not have any waste incurred. Caterers can also purchase food when it is in season, such as Copper River Salmon, and then serve it year round.

In addition to protein products, dry goods, such as those used in the chicken cashew salad or the roasted Kahlua pork can be frozen to increase shelf life. Many items such as grain, nuts, butter and flour can go rancid if they are stored at room temperature for too long. By freezing them the shelf life is extended to a year. This also applies to bread products. They will maintain freshness for a month or more when held in a freezer.

Berries can be very expensive when purchased out of season. They can be flash frozen in hard sided containers and they will maintain the shape, flavor and moisture of fresh berries. They will be similar to IQF (individually quick frozen) berries purchased by foodservice operations but will not contain any added sugar or preservatives.

In addition to quick freezing, some models of blast freezers are equipped with a program for defrosting products. Thawing products takes much longer than freezing. This is because ice conducts heat four times faster than liquid water. During thawing, the surface warms and thaws quickly, and the resulting layer of liquid water conducts heat into the food more slowly than the ice did, so thawing deep in the food takes longer (Myhrvold et al., 2011a). The safest way to thaw products is under refrigeration. This is sometimes difficult due to lack of space in the refrigerators. Many times cooks place food in sinks and use running water to thaw the product. This can result in loss of quality and possible contamination of the food. By utilizing this feature in the blast freezer, product can be thawed quickly without loss of quality or risk of contamination.

For companies that are required to maintain HAACP records, or just prefer to maintain time and temperature records, many of the models are equipped with data recorders and built in printers. Many have the ability to be connected directly to a PC and can have the information automatically downloaded to a spreadsheet. This is an excellent way to keep the records required by many health department districts.

The cost of these units varies widely. It is necessary to look at each operation and determine the volume of production and the needs against the cost of the unit. Prices range from an under counter unit that is suitable for smaller operations, priced around $6000, to the larger

units with multiple features costing around $35,000 or more.

Reduced Oxygen Packaging

Reduced oxygen packaging (ROP) is a packaging method used to prevent the growth of microorganisms by reducing the oxygen in the packaging. This method includes MAP (modified atmosphere packaging) where oxygen is replaced with other gases such as nitrogen or carbon dioxide and vacuum packaging such as that used for sous vide cooking. MAP is not common to foodservice establishments but is used extensively in wholesale food production. Many fresh cut produce items are packaged this way.

Vacuum packaging for food storage is a method commonly used to prevent food spoilage during distribution. Supermarket shelves are full of vacuum-packed meat, cheese, coffee, and ready to eat foods. This method of storage substantially increases shelf life because it removes oxygen from contact with food. Oxygen is highly reactive and causes oxidation of meats, and some fruits and vegetables. It is also essential to the growth of spoilage bacteria, almost all of which are aerobic (requiring air to reproduce). By removing the air from around the food, vacuum packaging forestalls the two biggest causes of food degradation with age: direct oxidation and aerobic microbial growth (Myhrvol et al., 2011b)

Another benefit of packaging foods with this method is the efficient use of storage space. When storing food in a bag, you in effect create the perfect size container. It also allows the caterer to store food bought in bulk in smaller containers so it is not necessary to continually open and close a product when only using small quantities.

Many of the items on the menu can be stored under vacuum in specific portion size servings. This would work well for the meatballs or chicken wing. This is also beneficial for

marinating items such as the lemon chicken. Many of the sauces can be held frozen either separate or together with the appropriate food such as sweet and sour chicken. Bags can have a standard of 25 portions per bag. The bags can be held with the food either raw or pre-cooked. If a function for 50 people requires meatballs, the cook can pull two bags from the freezer then heat the product without creating any waste. If held separately, the appropriate sauce can be added to a cooked product. Then it can be heated and held using a sous vide technique. This frees up space on the stove for preparation of other foods.

Different types of equipment can be used for ROP packaging. Edge sealers are commonly used in many home kitchens. The most familiar brands are "Food Saver" and "Seal-A-Meal". These are known as edge sealers. They are inexpensive, priced around $100 to $150. While they will work for foodservice operations, they are not designed for large production. There are a few problems inherent to them based on the way they operate. They are as follows;

1. Vacuum pump is not very powerful, so packages cannot be sealed as tightly.
2. The air is sucked out of the end of the bag and this caused the product within the bag to be pulled into the vacuum pump. This can be addressed by freezing the liquid first.
3. The machine requires the use of waffle-textured bags in order to work properly and they are somewhat expensive
4. Shape of the food was ruined. Delicate food such as berries can be stored in ridged container and kept under refrigeration (freezing is not recommended) (Myhrvold, et al., 2011b).

The most common way for restaurants to use ROP techniques is with the use of a

chamber-style vacuum sealer. The main drawback to their use is that they are large, heavy and relatively expensive. They range in price from $2500 to $5000. The operation of this equipment is fairly straight forward. Food is placed in the bag and the level of vacuum is set. Chamber sealers have several adjustments available including pressure and sealing time. The bag is placed in the chamber with the open end extending across the sealing bar. When the lid is closed the vacuum begins and removes the air from the chamber and from the inside of the bag. The sealing bar heats and seals the bag, and then the air is allowed back in. This causes the bag to push tightly around the food. Another advantage of a chamber sealer is their high throughput. A single machine in a busy kitchen can seal hundreds of bags a day (Myhrvold et al, 2011b). There are other benefits to vacuum chambers that allow for unique preparations. Fruits with very high water content such as watermelon and pineapple can be cut into uniform pieces then vacuumed tightly, then chilled. This concentrates the water and creates a much more flavorful product. This is helpful when fruit trays are needed in January and the quality of the fruit is poor. This also works well on spinach that is to be sautéed for service. By concentrating the water in the leaves, it spinach cooks to a much firmer texture with very little water loss. Marinating proteins is also more effective when it is done under vacuum. The flavors penetrate the product in a shorter period of time and are absorbed deeper into the meat.

The use of any type of ROP packaging for storage or sous vide cooking requires the company to implement a HACCP plan and obtain variances from the local Health Department.

In Clark county, Nevada the Southern Nevada Health District requires a four part plan to be submitted to obtain a variance. The process begins with the creation of a priority assessment that includes a list of the foods, preparation methods, and equipment involved in the production.

A detailed flow chart of the food as it moves from receiving to service must be developed. For each food group or recipe utilizing ROP a hazard analysis worksheet must be developed. Critical control points, the points in the process where hazards can be prevented or reduced to a safe level, must be established and identified. This, along with other supporting documents such as a list of standard operating procedures, plans for training employees, and documentation logs must be submitted and approved (see Appendix).

Food safety training and the ongoing management of the food production system are critical functions of any food service operation. Public awareness of food safety is growing and the public's once blind trust of the food industry is gone. Customers are more aware than ever that improper food handling can have devastating results (Gregoire & Spears, 2007). To this end, a company that uses HACCP in their operations may appear to be the best choice for a consumer. There is considerable documentation required to use ROP as a storage method. Any company desiring to do so would have to weigh amount of training and oversight required against the value of implementation of such a program.

Production

Sous Vide Cooking

The classic approach to sous vide cooking is to use a chamber sealer to seal food inside a plastic bag. The bags come in a wide range of sizes with varying prices. They differ in thickness and oxygen-barrier rating makes them suitable for different applications such as immediate service, refrigerated storage, or freezer storage.

In any foodservice operation that is preparing a special function there needs to be food pre-preparation generally performed a day or more in advance. This includes all the food

production steps that can be done ahead without compromising the quality of the finished menu items. It is necessary to do a significant amount of pre-preparation if the party is large (Sgovio, Shock & Stefanelli, 2011). This is especially true if the function is to be done offsite and kitchen facilities are limited.

The standard procedure for producing a banquet of 5,000 New York steak dinners is to grill-mark the steaks in the morning then chill them in the refrigerator. They are then roasted in an oven nearer service time. They would then be plated, sometimes several hours in advance, and held in a holding cabinet. Quality cook-and-hold equipment will maintain the product's temperature for several hours but many times the meat ends up overcooked and dried out.

There are several options for a caterer who chooses to use the sous vide method for production. This method allows the foods to be finished or semi-finished about a week or more before they are needed. Foods can be cooked partially or completely and chilled, then vacuum packaged for refrigerated storage until needed. Food that has been partially cooked can be finished in a low temperature water bath or if the food is completely cooked, it can be reheated by the same method. With the steaks mentioned, above the procedure would change to grill-marking the steaks several days in advance, chilling and vacuum packaging them, and then cooking them in water bath to a specific doneness. This can be done several hours in advance and the meat held in the water bath at that specific temperature to maintain exact doneness. They can then be plated at service with no chance of overcooking (Sgovio et al., 2011). If desired, the steaks can be cooked in the bath to a slightly lower than desired doneness and then grill-marked just before plating. Either method would present a much more desirable finished product. The grilled salmon could be handled in a similar manner. Again this method requires a much less

skilled employee to achieve a quality result.

Sous vide offers several culinary advantages. It allows foods to be served to a large group of people while simultaneously maintaining quality control. If the caterer uses as many pre-prep items as possible it will give them more control over labor work schedules, and allow the production labor to be more efficient (Sgovio et al., 2011).

Many of the other menu items can benefit from cooking sous vide. Shell eggs used for deviled eggs are normally boiled or steamed in a steamer. This can result in under or overcooking. When using a water bath they can be cooked to the perfect doneness and this prevents the unpleasant tasting sulfur ring from forming around the yolk. This method does not require them to be in a vacuum bag or any bag at all. When shrimp are served at a party, more often than not, they are overcooked. Controlling the cooking temperature of large batches of seafood is difficult when using traditional production methods. For shrimp that is to be served cold, the most common way to cook then is to boil them. Usually this results in overcooking because they are not pulled from the hot water fast enough nor placed into the ice bath to stop them from cooking quickly enough. They also loose a significant amount of flavor into the water or steam. This can be prevented by cooking them in a bag to a precise temperature which eliminates the worry of overcooking and does not allow for any loss of flavor. This is also a problem when cooking asparagus for large groups of people. Usually it is boiled or steamed and results in a poorly cooked finished product. If the asparagus has to be held in a warming cabinet for any length of time it usually is significantly overcooked. By cooking them in a bag in a water bath, with or without a vacuum, the results are always controllable.

Low-temperature cooking is the shorthand term for heating foods just at the temperature

for ideal doneness. It is usually done in a water bath whose temperature can be precisely controlled. It is excellent for meats, fish, eggs and other heat-sensitive foods that are easily dried out at standard cooking temperatures. The chicken used in the chicken cashew salad or the smoked cranberry chicken would benefit from this cooking method. Flavors could be added to the raw product including the smoke flavor, then the chicken could be cooked sous vide and served either hot or cold. The advantage of low-temperature cooking is that it guarantees an exact doneness throughout the food as shown in the steak and shrimp examples. Once food reaches the perfect temperature, it can be held in the water bath for an extended period of time without the risk of overcooking. This allows the cook to be focus on other projects as the cooking time is less critical. The disadvantage of this method is that it doesn't create the rich, savory surface flavors that high-temperature cooking does. This can be overcome by browning the product either before or after the low temperature cooking process (McGee, 2010).

Several of the items on the menu require long cooking times in order to tenderize the protein. These include the beef stroganoff, sweet and sour pork, and short ribs. Traditionally, these items are browned then covered and braised for several hours. This allows for the breakdown of the connective tissue and results in a tender finished product. This requires the cook to attend to the pot to prevent the liquid from evaporating and the food from scorching. Using the low temperature cooking method, results in a very tender finished product without the required attendance of a cook. This type of cooking does require an extended period of time. The short ribs can be cooked up to 72 hours with excellent results.

As mentioned, this type of cooking process utilizes fairly inexpensive equipment. An immersion circulator is the most popular type of equipment for maintaining the temperature of a

water bath +/- 1°C. They range in price from $800 to $1,200 dollars depending on the model. The water baths can be as simple as a large stock pot or a Lexan (large plastic container), or a company can purchase an insulated container designed specifically for low temperature baths for $100 or more.

Combi-Oven Cooking

Heat is just one of two critical factors that determine how food is cooked. The other is humidity: the water content of the air surrounding the food. Humidity governs the temperature at which the food actually cooks. It is also critical in insuring the surface texture of the finish product. The ability to manipulate moisture, both inside and outside of the food is one of the factors that make the modern combi-oven so desirable. These types of ovens allow the user to control the water content of the heated air, so they can preserve the moisture content of the food being prepared (Myhrvold et al., 2011b).

The availability of several cooking modes allows a caterer to use the oven in place of several other pieces of equipment. Chef manager Rob Lawson, from Thornton Hall Catering, manages a facility that services up to 400 guests. He uses a combi-oven to chargrill 200 chicken breasts in three minutes. He also uses them to cook turkeys overnight and hold them for service or to produce a meal for 150 without the need for other cooks. Others have found that they can feed a group of 40 a full breakfast of eggs, bacon, sausage, hash browns, fried bread in 15 minutes, all cooked in one oven ("My combi and me," 2006).

Low temperature steam mode can be used to cook as though using a covered pot or a sous vide bag. It is excellent for cooking items such as crème brûlée or flan without the use of a water bath. In the steam mode, the oven works as a steam chamber and is excellent for cooking

vegetables or any plant-based food.

With the dry heat modes, it is possible for a caterer to bake products or reheat with precision temperatures. Roasting can be done with the use of a probe to prevent overcooking of expensive protein products or set on slow roast to prevent shrinkage. The traditional method of cooking large pieces of meat such as prime rib or Kahlua pork is to place them in an oven at 325° and cook them for 4 to 5 hours. With the combi-oven it is possible to preset the oven to cook overnight and stop when the desired temperature is reached or it can be set to cook and then hold the finished product. This allows the product to cook without having an employee oversee the production. It is also possible to fry and grill in many of the brands of combi-ovens and most include a self-cleaning feature. One of the cost saving features on this type of oven is its' ability to carry out programmed recipes automatically. A caterer can customize their own program to their recipe specifications and guarantee excellent results every time. The caterer can then employ cooks that are less skilled and less expensive, and still obtain quality results (Myhrvold et al., 2011b).

Table 4

Modernist techniques applied to a typical catering menu

Food Item	Ingredient	Applicable Modernist Technique
Seared Ahi (tuna)	Fresh Tuna Loin	Blast Freezing, ROP, Combi-oven
Caviar Deviled Eggs	Boiled eggs	Sous Vide
Roast Beef Roulade	Beef	Blast Freezing, Sous Vide
Grilled Salmon Medallions	Fresh salmon	Blast Freezing, Sous Vide, Combi-oven
Jumbo Shrimp	Shrimp	Blast Freezing, Sous Vide, Combi-oven

Food Item	Ingredient	Applicable Modernist Technique
Chicken Cashew Salad	Chicken, Cashews	Blast Freezing, Sous Vide, Combi-oven
Smoked Cranberry Chicken	Chicken	Blast Freezing, Sous Vide, Combi-oven
Raspberry Chipotle Meatballs	Raspberries, Sauce, Meatballs	Blast Freezing, Sous Vide, Comb-oven
Chicken Wings	Chicken wings, Sauce	Blast Freezing, Sous Vide, Combi-oven
Fruit Trays	Fresh fruit	ROP
Lemon Chicken	Chicken	Blast Freezing, Sous Vide, Combi-oven
Beef Stroganoff	Beef, Sauce	Blast Freezing, Sous Vide, Combi-oven
Roasted Kahlua Pork	Pork, Sauce	Blast Freezing, Sous Vide, Combi-oven
Short Ribs	Short ribs, Sauce	Blast Freezing, Sous Vide, Combi-oven
Prime Rib	Rib Roast	Blast Freezing, Combi-oven
New York Steak	New York Steaks	Blast Freezing, Sous Vide, Combi-oven
Sweet and Sour Pork	Pork, Sauce	Blast Freezing, Sous Vide, Combi-oven
Steamed Asparagus	Asparagus	Sous Vide, Combi-oven
Potatoes	Potatoes	Sous Vide, Combi-oven

Conclusion

Hospitality technology has advanced through innovation in the application of both machines and tools, and systems and organization. Because the nature of food service is practical, or hands-on, innovation is easily and quickly adopted if it can be shown to be effective. Changes can come in many ways but basically new ideas are promoted by existing principals viewed with new eyes (Muller, 2010).

Such is the case with modernist cuisine. Here the technology of freezing is advanced using the long understood principals of ice formation and then made available to small foodservice operations such as caterers and restaurants. Cooking techniques have progressed from using a spit over an open fire to programmable ovens that take the guess work out of the "is it done yet" question. While food and labor costs continue to rise, so has the public's culinary awareness and expectations. This places the caterer in the position of needing more innovative menus without increasing costs so as to stay competitive in a competitive marketplace. As has been shown, it is possible to obtain excellent results with less skilled employees. Many times the results will surpass the flavors and textures achieved using traditional methods of cooking.

In the next decade there will be more knowledgeable and experienced consumers with demands not only for innovative foods but greener offerings created in an energy efficient way. It is possible that companies may find that capital investments in new technology will result in higher return on investments (ROI) and have a longer impact on profitability (Muller, 2010). Just as Escoffier created new kitchen technology over a century ago that changed the way foodservice operated, so will the advancements in modernist culinary techniques and equipment change the way foodservice operates into the 21st century

Recommendations

Catering operations need to look to modernist techniques and equipment in order to stay on the cutting edge of culinary trends and yet remain profitable by controlling food and labor costs. While the initial capital investment may be large on some of the equipment, the ROI can prove to be well worth it. Many of the techniques can be adopted with little capital outlay but still be will prove to be profitable. Companies should examine their current standard operating

procedures (SOP) for production of their menu items and look to replace them with modernist techniques that will cut costs and still provide quality products.

Selecting a New Food Service Methodology

The main steps in selecting a new system of food production are common to the implementation of any strategy. This includes the identification of a need, in this case to increase productivity and lower costs. This is followed by an evaluation of the different options available and selection of one option. For catering operations, this could mean moving from a traditional cook-hot-hold-service model or cook-chill-reheat-serve model to a long shelf life (LSL) cook-chill-low temperature heating model or LSL cook-freeze model. Following the implementation of the new system, the outcomes are analyzed. The advantages and disadvantages of any system must be assessed. Productivity must be evaluated in terms of its potential increase in meal production. This must be weighed against the costs involved in the implementation of the new system (Rodgers, 2005). A simplified evaluation of the modernist methods is shown in Table 5.

Table 5

Evaluation of modernist methods

Method	Advantages	Disadvantages
Cook-hot-hold-service	No need for chilling and reheating; less time for temperature abuse; less energy consumption; less "in-stock" costs	Limited production due to time constraints High skill level of labor Plate waste
Cook-chill-reheat-service	Allows advanced preparation No quality damage due to freezing	Allows for loss of quality Short pre-production time Possibility of temperature abuse

Method	Advantages	Disadvantages
LSL cook-chill-low temp	LSL; less food waste due to flexible packaging; protection from re-contamination; vacuum retards chemical deterioration' no loss of juices and flavors; long time low cooking (creates tender meat, less cooking loss)	Requires capital investment Retraining of staff Space availability for equipment HACCP Plan required
LSL cook-freeze	LSL; possibility for "out of season" buying; minimal food safety risks; availability to ship off-site safely before reheating	Requires capital investment Retraining of staff Space availability for equipment HACCP Plan required

Note. Adapted from "Selecting a food service system: a review" by Svetlana Rodgers, 2005, *International Journal of Contemporary*

Finally, the introduction of a HACCP plan to any type of foodservice operation would prove to be a benefit in helping to prevent foodborne illness outbreaks. This is especially true for catering operations due in part to the fact that many of the foodservice workers are temporary hires and may not adhere to company policies on proper sanitation procedures. In addition many times food is transported out of the relatively safe environment of a foodservice establishment and taken to remote locations that do not offer the necessary safeguards against contamination. By having a HACCP plan in place this would become much less of an issue.

Appendix;

HACCP Plan Requirements

A. Priority Assessment Information

1. Food involved in the HACCP Plan – Provide a list of the foods involved and all ingredients used in preparing any food handled in special process.

2. Food service system – Specify the food preparation and service system you will use, i.e. smoking, curing, cook-chill, sous vide, reduced oxygen packaging (ROP).

3. Equipment and materials involved in the HACCP Plan – Provide a list of equipment and materials used in the HACCP plan, i.e. for ROP the equipment used to bag the food and the type of bags that are filled.

4. A list of all facilities, including location and permit number this HACCP Plan pertains to.

Note: If the process described in this plan affects multiple locations and the process is carried out in each facility the same, one HACCP Plan is sufficient. Separate plans will be needed if more than one process is carried out. For example, if both cook-chill and sous vide are done, separate HACCP Plans will be required for each process.

B. Process Flow Diagram

1. Provide a detailed diagram of the flow of food through your process starting with receiving and continuing through service of food.

2. Identify all critical control points (CCPs) on the flow diagram with cross references on your HACCP Worksheets.

C. Hazard Analysis Worksheet

1. For each food grouping or recipe, fill out a Hazard Analysis Worksheet.

2. Circle/check the operational steps that are of concern on the left side of the sheet.

3. Under the Hazards side of the sheet, fill in any hazards that are of concern depending on the ingredients. Be mindful of pathogens that could be introduced by employees. These issues need to be identified on the Hazard Analysis Worksheet. Some hazards will fit into more than one category; however, they only need to be captured one time. For example, Norovirus could be listed under Viruses and Fecal / Oral Route Hazards. As long as it is captured in one of the categories it is sufficient.

4. Be aware that not all hazards can be controlled at CCPs. Some of the identified hazards will need to be addressed through Standard Operating Procedures (SOPs). Samples of these are provided.

D. HACCP Worksheet

1. Working from the process flow chart, list all CCPs under **Critical Control Points** on the HACCP Worksheet.

2. Working from the Hazard Analysis Worksheet list all hazards under **Hazards** on the HACCP Worksheet. Hazards can be listed by grouping, i.e. vegetative bacteria, viruses, spore-forming bacteria.

3. Identify those hazards that cannot be controlled at a CCP. These hazards will need to be addressed in a SOP. For example, to control for Norovirus, a SOP will be needed to address employee hygiene and handwashing. These SOPs should be listed under the **Prerequisite Programs** and must be submitted along with the HACCP Plan.

4. Working from the CCPs fill in the remainder of the chart.

i. List the critical limit for the CCP, i.e. cooking of chicken has a limit of 165°F for 15 seconds.

ii. Describe how monitoring will take place and who will be responsible for the monitoring, i.e. line cook will take temperature using a calibrated thermometer when food has finished cooking to ensure critical limit has been reached.

iii. List the corrective action that should be taken if the critical limit is not reached and who is responsible to ensure the corrective action is followed, i.e. the chicken should be returned to cooking to reach internal temperature of 165°F for 15 seconds.

iv. List who is responsible to verify that the plan has been followed, i.e. chef will review records to ensure that the process has been followed, and that all critical limits have been met.

v. List the type of records that must be maintained to monitor CCPs, i.e. temperature logs with corrective action logs are to be maintained.

E. Other Supporting Documentation

1. Submit blanks of all log sheets, i.e. cooling logs, temperature logs.

2. Submit all SOPs, i.e. Hand washing SOP, Calibration of Thermometers SOP.

3. Submit a plan for training of employees in the process. Employees involved in the process must be trained and training logs must be maintained for all training that is done.

4. Should your plan require a Processing Authority or a challenge study, this documentation should be submitted at the same time that the HACCP Plan is submitted.

5. All support documentation must be submitted at the same time as the HACCP Plan is submitted.

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