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Upcoming Webinars

- **March 25 – Roots, fruits, and shoots:
Edible plant parts**

Asunta (Susie) Thompson, NDSU associate professor and potato breeder

- **April 1 – Safe home canning: Start with
the recipe, finish with confidence**

Karen Blakeslee, Kansas State University Extension associate



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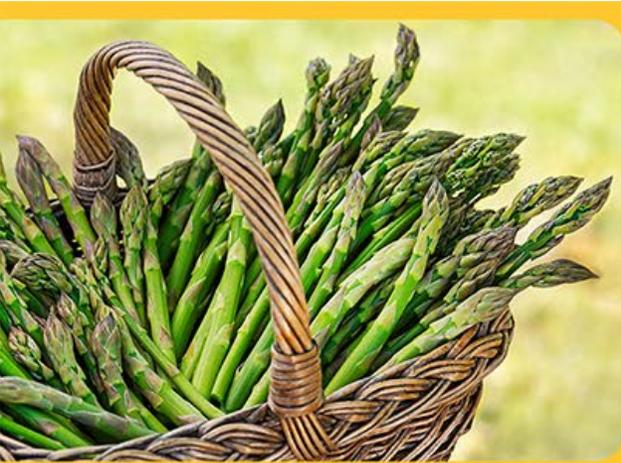
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March 18

To sous vide or not to sous vide: Safety of long-term, low- temperature cooking for vegetables

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**ARE YOU USING THIS TECHNOLOGY,
AND IF YES, WHAT ARE YOU MAKING?**

Sous Vide - Why is it so popular?

- Retention of volatile flavor compounds and improved juiciness because the product is sealed during cooking.
- Reduced oxidation, including lower flavor deterioration and better retention of color and some nutrients.
- Less leaching of water-soluble components than with boiling in water.
- More uniform heat transfer because air is removed and the bag stays in close contact with the product.
- Potential shelf-life extension when processing, chilling, and storage are well controlled.

Sous Vide - French for “Under Vacuum”

- Food processing technique in which raw or partially cooked foods are **vacuum sealed** in heat-stable plastic pouches and heated at precisely controlled temperatures for defined periods of time.
- The food is cooked in a **circulating water bath** to ensure uniform heat transfer throughout the product.
- Processing generally uses **lower temperatures** combined with **longer heating times**.
- Sous vide processing relies on **three fundamental elements**: Vacuum packaging, precise temperature control, and controlled storage and distribution.

STEP 1: Vacuum Packaging

- **Reduced oxidation:** Oxygen is responsible for many chemical reactions that degrade food quality, including lipid oxidation, pigment degradation, and vitamin loss.
- **Improved heat transfer:** Air is a poor conductor of heat. Removing air from the package allows water from the cooking bath to transfer heat more efficiently to the food surface, improving heating uniformity.
- **Reduced moisture loss:** In conventional cooking, juices and water-soluble compounds often escape into the cooking environment. In sous vide processing, these compounds remain inside the sealed pouch, helping maintain juiciness and flavor.
- **Reduced post-processing contamination:** Once sealed, the pouch acts as a barrier to environmental contamination during cooking and storage.

STEP 2: Precise Temperature Control

- **Uniform cooking:** Water has a high heat transfer coefficient, which allows food to heat evenly throughout its structure. This prevents the overcooking of outer layers that often occurs with conventional cooking.
- **Controlled texture development:** Many structural changes in food occur at specific temperatures such as protein denaturation; collagen solubilization, and pectin breakdown in vegetables.
- **Pasteurization:** Sous vide heating can be designed to achieve **pasteurization**, meaning that vegetative pathogens such as *Salmonella*, *Escherichia coli*, and *Listeria monocytogenes* are reduced to safe levels.
 - The time required for pasteurization depends on both temperature and product characteristics.

STEP 2: Precise Temperature Control (cont.)

- Short-time higher-temperature processing
 - Foods are heated to higher temperatures for relatively short periods.
 - Vegetable processing at 185 °F for several minutes
- Low-temperature long-time (LTLT) processing
 - Foods are cooked at lower temperatures for extended periods.
 - Meat cooked at 131–150 °F for several hours
- The appropriate combination depends on:
 - Product type
 - Desired texture
 - Microbiological safety targets

Table 1: Typical sous vide cooking temperature ranges for various food categories

Fish	122-158 °F
Meat (beef, pork)	131-176 °F
Poultry	140-176 °F
Vegetables	185-212 °F

- Vegetables require the highest temperatures because plant cell walls (cellulose and pectin) need higher heat for softening and enzyme inactivation.
- Most vegetable sous vide processing occurs near boiling temperatures (185-203 °F) but for shorter times compared with meats.
- Lower temperatures are common in meats to control texture and doneness, whereas vegetables require temperatures sufficient to break down plant tissues.

Table 2: Time/temperature combination for sous vide cooking of vegetables

Vegetable	Temp (°F)	Time	Notes
Carrots	183-194 °F	30-60 min	Softens pectin while maintaining sweetness and color
Potatoes	194-203 °F	45-90 min	Requires higher heat to gelatinize starch
Green beans	183-194 °F	20-40 min	Maintains bright color and firm texture
Broccoli	185-194 °F	15-30 min	Prevents overcooking and preserves chlorophyll
Asparagus	180-185 °F	10-20 min	Very short time to maintain crisp texture
Beets	185-194 °F	60-120 min	Dense tissue requires longer heating
Corn	183-194 °F	25-40 min	Enhances sweetness by retaining sugars
Cabbage	185-194 °F	30-45 min	Maintains texture and reduces sulfur odor

Sous Vide Process Flow

1. Ingredient preparation

2. Packaging

3. Thermal processing

4. Rapid chilling (cook-chill systems)

5. Refrigerated storage

6. Reheating and service

Storage and Distribution

- **Cook-Serve Systems:** Food is vacuum packaged, heated, and served immediately.
 - Minimal storage time
 - Reduced microbiological risk
 - Commonly used in restaurants
- **Cook-Chill Systems:** Food is vacuum packaged, pasteurized, rapidly cooled, and stored under refrigeration.
 - Extended shelf life
 - Common in institutional catering and food manufacturing
 - Requires strict temperature control during storage and distribution.

Hazard group	Main organisms	Why they matter in sous vide
Cold-sensitive vegetative pathogens	<i>Salmonella</i> , pathogenic <i>E. coli</i> , <i>Campylobacter</i> , <i>Staphylococcus aureus</i>	Usually controlled by adequate pasteurization and proper refrigeration, but they remain concerns in very lightly processed or sub-pasteurization products.
Cold-tolerant vegetative pathogens	<i>Listeria monocytogenes</i> , <i>Yersinia enterocolitica</i> , <i>Aeromonas</i> spp.	Can survive inadequate heating and then grow during chilled storage. <i>Listeria</i> is the usual target organism for short-life pasteurization.
Psychrotrophic spore formers	Group II nonproteolytic <i>Clostridium botulinum</i> , psychrotrophic <i>Bacillus cereus</i>	This is the most important hazard for long-life chilled sous vide because spores can survive pasteurization and grow during storage if temperature is not controlled.
Mesophilic spore formers	<i>Clostridium perfringens</i> , Group I proteolytic <i>C. botulinum</i> , mesophilic <i>B. cereus</i>	These survive cooking but are mainly controlled by rapid cooling and strict refrigeration because they do not multiply well under proper chilled storage.

The 10-Day Rule for Chilled Sous Vide Foods

- Pasteurized vacuum-packaged foods stored under refrigeration should have a shelf life of no more than 10 days unless additional safety controls are applied.
- Sous vide treatments do **not destroy bacterial spores**, including those of *Clostridium botulinum* and *Bacillus cereus*.
- Because spores can survive cooking and potentially germinate during storage, they present a safety concern in vacuum-packaged foods.
- This risk is particularly important in sous vide products because vacuum packaging removes oxygen, refrigeration temperatures may still allow the growth of certain cold-tolerant pathogens, and foods may appear normal even if toxin production has occurred.

Practical Takeaways for Vegetable Sous Vide

1. Vegetables require higher temperatures than meats
 - Most vegetables are processed between 180-203 °F, close to boiling.
2. Texture depends on pectin breakdown
 - Heating softens plant cell walls while preserving structure.
3. Shorter cooking times preserve color and nutrients
 - Vacuum packaging limits oxidation and nutrient loss.
4. Rapid chilling is important for cook-chill systems
 - If vegetables are stored after cooking, they should be rapidly cooled and refrigerated.

A close-up photograph of a person's hand holding a variety of fresh vegetables. The hand is cupped, supporting several yellow-skinned potatoes, several bright orange carrots, and bunches of green leafy herbs like parsley and dill. The background is a plain, light-colored surface.

**To sous vide or not to sous vide:
Safety of long-term, low-temperature
cooking for vegetables**



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