THE USE OF WOODS IN MEAT PRESERVATION AND TANNIN EXTRACTION

by

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in partial fulfillment of the requirements for the degree of Bachelor of Science

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THE USE OF WOODS IN MEAT
PRESERVATION AND TANNIN EXTRACTION

Introduction:
The art of preserving meats by curing with salt and then smoking is one that has been practiced from remote antiquity. Directions appear in ancient writings and the art is still practiced among primitive people. Yet, not withstanding the ancient origin of the art and its economic importance, adequate and comprehensive scientific study (with publication of results) has never been given to it. Even at present the scientific publications on the subject consist largely of recipes and formulas or the results of desultory and isolated experiments.

I feel that any industry that uses over one million cords of hardwoods a year demands attention from foresters, and that a thorough investigation is not amiss.

History:
Historically, it is believed that smoking was the means used to keep off the flies and other insects during the time that strips of fresh meat, salted or unsalted, were drying in the sun. Grown accustomed to the appearance and flavor that the smoke gave the meat the custom has persisted even though insect protection is no longer needed. Investigations bear out the fact, that the benefit derived from smoking meat is not entirely a matter of keeping away insects, but that the chemical constituents of the smoke have a decided preservative effect on the meat.
Chemical nature of smoke:

In all cases of smoked products, the effect depends upon the absorption of sufficient chemicals from the smoke to preserve the meat, to fix the color and to develop that distinct flavor and texture which distinguishes smoked meat from fresh meats.

Smoking first dries the meat, especially on the surface, and thereby helps prevent the growth of bacteria. The exposed meat, already deprived of part of its natural moisture, becomes dried still further, and is partly penetrated by such chemicals as acetic acid, creosote, formaldehyde, and other preserving elements, that are contained in the smoke. Some of the constituents, especially formaldehyde have a strengthening action on the meat muscle, thus keeping it firm. The general consensus of opinion is that creosote and the formaldehyde are very poisonous substances, and doubtless a great outcry would be heard were any one to use them for preserving food. But so long as these chemicals are absorbed by the meat through the smoking process no objections are raised.

There is a difference of opinion concerning the amount and value of the chemicals (impacted to the meat by the smoke) as a preservative. As formaldehyde has long been known to be a constituent of wood smoke, it was thought, by the Bureau of Fisheries, that this might be the preservative factor in smoking fish. From experiments carried on by them it was found that formaldehyde, though present in small amounts in the smoke and in the fish, is of negligible preservative
value in the production of first quality cold smoked fish. The bactericidal properties of smoke in the concentrations which are used to flavor fish products has been greatly over estimated, according to the Bureau. They pointed out that only small amounts of formaldehyde were found in any of the smoked fish. The chief preservative action seemed to be due to dehydration and heat, but for the best tasting product both heat and dehydration should be avoided, by placing the meat as far as possible away from the heat.

A large firm of bacon curers recently raised the question, "What are the preservative agents introduced by smoking?" This question drew the attention of the Federal Food Investigations Board to the fact that smoked bacon and hams gave a strong reaction to formaldehyde, whereas, unsmoked hams and bacons gave only a faint or negative reaction. The smoke was suspected as the source, but a search of the literature on wood distillation failed to reveal any record of formaldehyde. This is not surprising when it is remembered that distillation of wood is carried on in the absence of air while for the production of smoke, air is essential. In the wood distillation method, methyl alcohol is produced and this on oxidation gives rise to formaldehyde. This substance therefore is a component of wood smoke.

From experiments carried on with birch wood and birch wood sawdust the amount of acetic acid was diminished and the amount of formaldehyde was slightly increased with admission.
of air. If formaldehyde is one of the bactericidal constituents of smoke (and in the light of experiments carried out it appears to occur in quantities of three or four grains to the hundred cubic feet of smoke) it follows that one should pay particular attention to the density of the smoke to assure the proper degree of color, flavor and keeping qualities. It can be seen that in the smoking process itself, besides the bactericidal action of substances like formaldehyde, the smoke creates an unfavorable medium for bacteria propagation.

Smoke substitutes:
Commercial preparations in the form of 'liquid smoke', 'smoked salt', etc., may be used instead of genuine hardwood fire smoke. However meat so treated is prohibited from sale to the public by a federal meat inspection regulation. The reason given for this regulation is that there is a greater amount of harmful ingredients in artificial smoke than in fire smoke. Experiments conducted on the smoking of meat does not bear out this conclusion. Dr. Glessen of the Chemistry department at Oregon State College states, that there is no reason to believe that meats smoked by liquid or so called liquid smoke contain any more harmful ingredients than those subjected to smoke from hardwood fires. I am submitting along with this report, liquor distilled from the wood of Juniper (Juniper occidentallis) and from Mountain Mahogany (Cercocarpus ledifolius). Both of these woods are found in eastern Oregon and were used by Mr. J. A. Sandmark in experiments he conducted in smoking meat under pressure. The
liquid was painted on the meat and although it acted as an excellent preservative, it imparted an unfavorable taste to the meat. The Juniper wood can be used in the smoking process, but the Mountain Mahogany proved entirely unsatisfactory under every condition. A prerequisite for fuel used for smoking meat is that (1) it not only increases the keeping qualities of the meat, but that (2) it gives it a distinctive flavor. Some experts also say that smoking increases the palatability of the meat, but that is still a controversial matter. It has never been alleged, so far as I am aware that smoked meat is unwholesome.

Smoke houses:
The popular notion that the method of smoking employed in large packing houses varies materially from that employed on the farm, is erroneous. The only difference is that the smoke rooms of the packing houses are on a much larger scale and the meat is arranged in a number of tiers. In the larger packing houses, the smoke houses are indoors. They extend like large chimneys through several floors with doors and hanging space at each level. A fire pit extending some five feet below the lower floor level, produces the heat and smoke to treat, at one operation, all that is hung on the several floors. The walls are approximately thirteen inches thick. The thick walls retain heat more uniformly and economically, and promotes efficiency in the more convenient handling of the meats. The above plan lends itself admirably to smoking in one operation meats which require different
degrees of heat. The higher the product is hung above the fire the cooler the smoking.

Approximately two and one-half cords of wood and eight barrels of sawdust is employed for a single room which may contain sixty thousand pounds of shoulder or ham or twice that amount of side meat. Swift and Company has forty-three such smoke rooms of this capacity and eleven half as large so one can readily see that there is an enormous amount of wood consumed in a year's time just by this one establishment. During the summer months they turn out five hundred to seven hundred thousand pounds of smoked meat per day—not including sausages.

The only fire hazards in the modern smoke house are the sausage sticks, the products that are being smoked, and the fuel. Soot must be brushed down to prevent fire. The smoke house at the Long Tom Pork Farm near Monroe, Oregon is coated with a hard black substance. It is a deposit resulting from the combination of the grease contained in the steam from the meat being smoked and the smoke itself. It is flint like in appearance and will not rub off even on a white cloth. Certain woods produce more soot than others—the soft woods producing much more than any of the hardwoods.

The occasion might arise where the reader may want to smoke meat or fish so I will give briefly the details of an outdoor smoke house. Square houses are more efficient both in the use of space and labor. The walls of the smoke house should be thick and a double roof with an air space should be
provided to shield the smoke house from extremes of heat and cold and to prevent drip from above in cold weather. Where the construction is of wood a degree of safety can be provided by keeping the fire in a metal pot or kettle, with an air vent in its bottom, placed in the center of the house. Or dig a fire pit three yards from the smoke house piping the smoke either under ground or along the surface into the middle of the building. Unless the house is at least eight feet in height, from floor to the top of the upper hanging rails it should never have the fire made inside. It is impossible to regulate either smoke or temperature when ventilation depends entirely on cracks between boards or perhaps a hole at the top. The house must be tight everywhere except the ventilator in the top and draft hole at the bottom—both of which must be capable of regulation.

Occasionally it is desired to smoke a small quantity of cured meat, and one of the best means to do this is to use a sugar barrel with the bottom knocked out. Dig a sufficiently large hole in the earth to permit the building of a good size fire. Over this hole place boards with an opening in them for the smoke to pass up into the barrel. Over the hole in the boards place the barrel. Build a fire and, after the wood used for making the fire is well charred, cover the burning wood with a quantity of sawdust, or corncoobs, so that the necessary smoke is produced and will smolder slowly. Leave a small opening to cause a draft to draw the smoke up. The opening for air should be sufficient to keep the fire going.
Smoking of meat:
When the meat has hung in the smoke house approximately six hours it is dry enough to smoke. Meat put into smoke before it is thoroughly cured, will puff up and become sour or it will show gray-green discoloration in the interior, with better color toward the surface. Dried cured meat is ready for smoking as soon as unpacked. After the drying period, it is necessary to keep a heavy smudge sawdust fire going. The volume of smoke issuing from the ventilators is the best indication of conditions inside. One method of making the smudge is to divide the fire so as to form a ring around the heap of unburned sawdust. Do not throw the sawdust on the flame, as this sends up a cloud of ashes and soils the meat instead of smoking it. The smoking of beef is largely a process of drying. If a very dark mahogany color is desired a lighter smoke may be carried through the entire drying process. At no time should the temperature of the smoke house be allowed to drop after it has been heated up, as this will cause a crust to form on the surface and it will then be impossible to dry the center of the meat. Such meat is known as shell dried.

Bacon is ordinarily smoked from eighteen to twenty hours, hams from twenty-four to thirty, and sausages for ten hours, while dried beef is smoked at a higher temperature for eighty five to ninety hours. The longer meats are smoked the greater the shrinkage. Time of smoking and the temperature should be watched closely. Should meats be desired for immediate use or sent to cool climates a lighter smoke may be given.
Smoking of fish:

Fish when cured by the simple process of smoking are of excellent flavor and may be kept several weeks if protected from mold. Most persons like smoked fish; others will find it an easy taste to acquire. Do not judge smoked fish by the hastily and carelessly prepared product that some fisherman are willing to sell. A couple of hours hard smoking may make a smoked fish in appearance but not in fact.

It is an interesting experience to smoke one's own fish. From earliest history, savages and those who lived near bodies of water from which fish were obtained have used wood smoke to flavor, dry, and preserve a portion of such fish for use as food in periods of scarcity. The smoking of fishery products has remained essentially the same through the many years since it first began until the present day. The methods used still depend largely upon the personal opinion or prejudice of the operator, with the result that each individual has different ideas about the correct wood to use, how the fire should be built, how long the smoking should be continued, the temperature of the smoke being used in the treatment, and finally, just what constitutes a perfectly smoked fish. In an attempt to unify some of the prevalent ideas and to give the reader the benefit of my investigations into this phase of smoking, I will give the principles involved in the proper smoking of fish.

To secure the best quality the fish should be smoked for about four hours, at an average temperature not exceeding one hundred degrees Fahrenheit. Sufficient sawdust should
be used to produce a moderately dense smoke. A slow wood fire is started and the house filled with smoke. Some build the fire directly under the fish and smoke them in two to three hours but this is too short an exposure. The fish should be left in the smoke house until cold to eliminate sweating.

Fuels used:
Green hickory is the best fuel obtainable for smoking all kinds of fish, and, when properly used, gives off a clear white smoke that colors the product a rich golden brown and imparts a flavor to the flesh that cannot be produced by any other wood. As a fuel it is very easy to regulate and will give off heat and smoke for hours with one firing. Dry oak is very good but produces a darker smoke which has a tendency to darken the flesh and give it a mild acid flavor. Soft or hard maple is sometimes used, but as a general rule, it burns too freely, though the product smoked with such wood has a distinct, sweet flavor that is greatly preferred by some. Green ash is as good as oak. It gives off a lighter colored smoke and the flavor of the meat is very similar to that produced by hickory smoke. Green willow gives an abundance of smoke and for this reason is excellent for use with other woods. The Long Tom Pork farm uses willow alone for smoking fish. The willow sawdust is scattered around the edge of the room and lighted at one end. It proceeds to burn slowly and uniformly and by morning the fish are smoked. Sawdust of all woods except the pine and fir is very good for dampening the fire, but usually it does not burn freely enough alone to create the required amount of heat. Corn cobs when clean are
very good. They give off a dense smoke, which unduly darkens the product, but on the other hand they impart a flavor that is very much liked by most people. Pine wood imparts a resinous flavor to the product, making it almost unpalatable; a small amount may be used with other woods when better fuels are not available in sufficient quantities.

The advantages one wood may have over another is in the flavor it produces and the fact that a smoldering fire is more easily controlled with hard, green wood than with soft or seasoned wood, and more easily with sawdust or planing mill shavings than with cordwood or sticks. Hard wood of any kind is preferable to soft wood. Resinous woods should never be used as they are likely to impart bad flavors to the product. Corn cobs are the best suited substitute for hard wood and may be used. Soft wood and corncobs give off large amounts of carbon in burning and this is deposited on the meat making it dark in color and sometimes rank flavored. Special flavors are credited to such species as apple, maple, pecan and hickory. To keep a fire going over long periods without attention a large hardwood knot is preferred.

Arranged according to their hardness, the order of preference for the more common woods is approximately as follows, with clean corn cobs included; Hickory, Beech, Oak, Ash, Apple orchard prunings, Hard maple, Birch, Elm, Basswood, Peach orchard prunings, Willow, Soft maple, Poplar, clean corn cobs, Cedar, Cypress, Tulip tree. For flavor, maple and hickory hold first place. A distinctive flavor can be given
to meats by smoking with any of the above and finishing with juniper or sassafras or better still, by throwing twigs or bark of these on the fire from time to time, throughout the smoking. Pine, fir, and other resinous or turpentine trees cannot be used and the same is true of walnut and other woods which produce an offensive odor in burning. Even cedar and cypress, and tulip tree should be avoided if any thing better is available. Green wood burns more slowly and is therefore more easily controlled than seasoned wood, however it makes little more actual smoke than an equivalent burning of dry wood. The greater proportion of moisture driven off as vapor only makes it seem to smoke more. Such vapor will affect the color of the product more or less. Dry heat as produced by seasoned wood produces the best color, but the dry wood gives more trouble in controlling the fire.

In commercial plants, gas up to $1.50 to $1.75 per thousand cubic feet can be used profitably. This is equivalent to about $7.00 to $7.50 per cord for wood. A gas fire makes it easy to reduce shrinkage, increase production and turn out a uniform product, but sawdust must be used with gas to create the necessary smoke.

Statistics collected during this investigation show that twenty-two million feet of hickory alone are yearly demanded by the four-hundred and seventy-three meat-packing establishments in the United States for smoking meat. That does not include what farmers cut for their own smoke houses, which is probably as much more. Nearly all reports state that hickory
is more satisfactory than any other wood for smoking purposes. It emits a maximum of smoke with no increase of heat; it imparts a pleasant flavor; it gives the meat a bright clear, yellow color that is uniform over the entire surface; it burns slowly and thus cures the meat thoroughly; and it smokes the meat with a minimum amount of shrinkage.

In order to satisfy the United States regulation restricting the amount of shrinkage, many packers sprinkle their wood with sawdust form mahogany, walnut, cedar, and other hard and soft woods. This sawdust increases the amount of smoke with no increase in shrinkage, and at the same time prevents particles such as wood ash, from rising and injuring the taste and color of the meats. The packers prefer split cord wood, in four foot lengths, and seasoned from three months to three years. Tops and limbs are seldom accepted, although round pieces down to two inches in diameter can be used.

Species used by packing plants and Indians:
The amounts of various kinds of woods used by commercial packers are; Hickory thirty-one thousand cords, Apple-twelve cords, Ash one-hundred and fifty-four cords, Aspen fifty cords, Beech-one-thousand-four hundred and seventeen cords, Birch-eight cords, California Live oak-fifty cords, California white oak-one-thousand-two-hundred and sixty-one cords, Chestnut oak-fifteen cords, Cottonwood-seven-hundred and forty-five cords, Elm-two-hundred cords, Fruit trees-ten cords, Gum-six cords, Maple-eight-thousand-six-hundred and fifty-five cords, Mountain Mahogany-thirty-six cords, Miscellaneous species-six-thousand-eight-hundred and nine cords, Oregon Oak-three-hundred
and forty-three cords, Pecan—eighty-five cords, Poplar (Utah) forty cords, Sycamore—thirteen cords, Utah white oak—ten cords, Walnut—twenty-four cords, Western Alder—seven-hundred and ninety-two cords, White oak—eighty-five cords, and Yellow pine—fifty-nine cords.

Most sections use the kind of hardwood available and that is the reason that some of the drier mountain areas smoke meat with the so-called Mountain Mahogany and in some sections of the Southwest the mesquite is selected. In some parts of Oregon Red Alder sawdust is used. Along the Oregon coast some farmers smoke their meat with vine maple and oak. One farmer reported that he used vine maple in curing salmon and had very good success with the green wood of that species. Another correspondent used Mahogany wood found in eastern Oregon but with little success. He used willow in smoking pork and found that this wood was satisfactory for smoking purposes. Where Hickory abounds that wood is generally preferred. There are, however, plants in hickory producing localities that use hard maple and occasionally black walnut for smoking.

The Lower Klamath Indians of California smoke beef, venison, and fish with alder. They cut the meat or fish in thin strips and then place these strips about six feet above a smudge fire of alder. Another method used is to spread the strips on splints and turn these regularly in the smoke for a week. The strips are then placed about twelve feet above the fire and left until dry. Occasionally smoke houses are used, with alder as the fuel.
The Shoshoneans of the great Basin usually use sage brush or juniper.

The Sac and Fox Indians of Oklahoma use Green poplar in smoking fish. The fish are cut into strips and treated with salt and oil secured from trees or buds, they are then placed on a rack over a smudge fire and left one to several days. The smoke house usually consists of a small teepee made of hides.

The Apache Indians of New Mexico cure beef venison by cutting the meat into thin strips. These strips are then placed on a rack of poles, barb wire fence, wagon wheels, etc., and left for the sun to dry. Occasionally it is smoked and when this is the case mesquite is used as fuel.

The Northern Cheyenne Indians of Montana give the same treatment to beef, but use Emory oak as fuel to produce the necessary smoke.

The Chippewa Indians of North Dakota seldom smoke meat, as they usually eat it as fast as they can get it. When they do have a supply to smoke they use paper birch as the fuel.

The Sioux Indians of South Dakota use a process similar to the Chippewa.

The Chippewa of Wisconsin cure venison by placing cubed strips of the meat on racks and holding it over live coals until seared. They then allow it to dry over heat and smoke from Eastern Hemlock bark.

The Iroquois of New York State, according to Dr. A. Parker of the Museum of Indian History, Rochester, New York, smoke venison hams, and bacon with the smoke of Yellow birch, Beech, Hickory
or corncobs. They are somewhat modern in their methods, using a smoke house and smoking the meat three to six days.

The Indians of Alaska make fish pemmican and meat pemmican by smoking the meat or fish over a slow fire made from any wood species available. Drift wood is often used. The smoked meat is then mixed with such dried fruit as Choke or June berries. This mixture, when compressed into thin bags and kept dry, may be preserved for four or five years. Pemmican is a staple food in the diet of these northern Indians.

From these primitive unsanitary methods to the clean modern smoking methods of the big meat companies of today is a big step in the smoking process, but in general the species used today are the same as those used in the past.

The following illustration supports the points brought out in the preceding pages that the difference in smoked meat depends, for one thing, on the species of wood used in producing the smoke. When one meat company spends over one thousand dollars for one page of advertising to bring this point to the attention of the buying public, the important role which wood plays in this industry is obvious.
The trick of a fine one-dish meal is THIS BACON WITH THE SWEET SMOKE TASTE!

The BRAND is SWIFT'S PREMIUM

Don't overlook it... how easily you can get high food value and tempting flavor in summer dishes with Swift's Premium Bacon.

An exceptionally mild bacon... uniformly so because of the expert Premium sugar cure... Swift's Premium is also noticeably richer in flavor. Special Swift way of smoking, in ovens. Ovenized increases the tenderness of the bacon and, from the fragrant hickory embers, develops a wonderfully delicious flavor best described as a sweet smoke taste. You'll like it!

Ask your dealer today for a half-pound or pound package of this leading brand—Swift's Premium Bacon. Swift & Company, Purveyors of Fine Foods.

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Dissolve 1 pkg. lemon-flavored gelatin in 1 cup boiling water. Add juice of 1 lemon and ¼ cup cold water. Cool. When beginning to set, pour it over whole hard cooked eggs, thinly sliced radishes and olives in individual molds. When set, unmold on watercress around the cold ham.

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Ham that needs no parboiling!
Swift's Premium Ham, because it has been given the famous Premium cure and then Ovenized (smoked a special way, in ovens) is exceptionally mild and delicious. You bake it this easy way: Place in a covered roaster with 2 cups water. Bake in slow oven (325° F.) until done, allowing about 21 min. a lb. for a large whole ham; about 25 for smaller (up to 12 lb.) hams or half hams. Remove from oven, skin, score fat. Dot with cloves and rub with bread crumbs and brown sugar. Cover with 1 cup pureed apricots. Brown in hot oven (450° F.) for 20 min.

Delicious—and all on one platter! Butter cooked egg noodles (1 pkg.). Mound on hot platter. Peel peaches; fill halves with blueberries. Mix together 1 cup brown sugar, ¾ cup butter, 1 egg yolk and ½ tsp. cinnamon. Pour over fruits; bake in moderate oven (375° F.) until peaches are tender (about 25 min.). In same oven, bake 10 or 12 slices of Swift's Premium Bacon, turning once. Serve as shown.

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How this summery ham dish is made.
With Swift's Premium Ham baked as directed at the right and chilled, serve these gelatin molds:...
Mr. Ashley A. Poust,
2019 Van Buren Street
Corvallis, Oregon.

My Dear Mr. Poust:

Replying to your letter of Jany 15th, I will attempt to explain about my experience in curing meats. In the first place, using willows for fuel, I experienced for 12 days with Hams, Bacon and Pork Shoulders, but found that the marrow would not keep in warm weather, but the meat was well cured to the bone. I then made another set up and let it stand for 14 days, under 250#/ pressure, and found this meat would keep indefinitely. This meat would be suitable in eight days for use in boiling, such as Ham.

I experienced with meat, using pure corn for fuel but this left a rather strong taste, similar to toasted bread; I believe this could be corrected by reducing the time.

I also experienced with mahogany wood found in eastern Oregon, but this was entirely unsatisfactory. I am sending you in today's mail, under separate cover, a small bottle of liquid I extracted from dry Mahogany wood, which I wish you would kindly analyze for your and my information. I am also sending a small bottle of liquid extracted from Juniper wood, which might also be analyzed.

I want to thank you for your interest in this matter and your willingness to assist me in these experiments, and will highly appreciate any further information you will give me concerning the best and latest methods of curing meats. If you desire, I will be glad to send you samples of meat I have cured.

Yours very truly,

J. A. Sandsmark
General Delivery—Burns
January 29, 1937

Mr. Ashley A. Poust
2019 Van Buren
Corvallis, Oregon

Dear Mr. Poust:

We were very pleased to receive your interesting letter and hope that we are offering you some help on your thesis.

We have no literature on meat smoking but here are the essential facts. The meat which we smoke, no matter in what region the plant is located, is smoked with hard wood or hard wood saw dust. The most preferable wood to use is hickory. We use that whenever it is practical to do so. In the event that hickory cannot be used, it is either smoked with oak or some other hard wood. The cost of the wood is the same as it would be for any other buyer of large lots. We purchase wood in great quantities at cord wood prices. The smaller sticks are more valuable than the larger sticks for smoking purposes.

We hope that this answers the questions which you have in mind. If you have any further questions concerning the packing industry, please let us know. We shall be glad to hear from you at any time.

Very truly yours,

SWIFT & COMPANY

[Redacted]

Agricultural Research

FMSimpson:ms
Mr. Ashley A. Poult
2019 Van Euren
Corvallis, Oregon

Dear Sir:

Reference is made to your letter of January 23.

I am sorry but we have no definite information relative to the woods used for smoking meat, nor have we carried on any experiments in this regard.

In the past a small amount of red alder sawdust has been used for this purpose. Also I understand that farmers smoking their own meats use various of our local hardwoods, particularly vine maple and oak.

Very truly yours,

J. ELTON LODEWICK, In Charge
Section of Forest Products

By: H. J. Johnson, Acting
Mr. Ashley A. Poust,  
2019 Van Buren St.,  
Corvallis, Oregon.

Dear Sir:

Your letter of January 23 is received.

Practically all native hardwood species have been used for smoking meats. Forest Service Circular No. 187 "Manufacture and Utilization of Hickory" lists more than 25 kinds of hardwoods used by meat packing establishments. The most largely used wood for meat smoking is hickory. Oak, maple, beech, and black walnut are also used in considerable amounts. Statistics on consumption of wood for meat smoking have not been compiled as far as we are aware since about 1910 when they were gathered for publication in the circular listed above.

In addition to the above, data on meat smoking and woods used can be had from Government publications on that subject as shown in U. S. Department of Agriculture Index to Publications 1901-1925 on page 1488.

The use of one hardwood or another for meat smoking is largely a matter of choice or convenience. Where hickory abounds, that wood is generally preferred. There are, however, plants in hickory-producing localities that use hard maple and black walnut for meat smoking.

For smoking meat and fish, the Indians probably used hardwood species most available to them. If authentic information along that line is recorded, however, it can probably be had from the Bureau of American Ethnology, Washington, D. C. We suggest that you write that source relative to that phase of your inquiry.

Very truly yours,

C. V. SWEET, In Charge,
Section of Industrial Investigations.

By [Redacted]
Wood Technologist
February 13, 1937

Mr. Ashley A. Poust,
2019 Van Buren,
Corvallis, Oregon.

Dear Sir:

Your request for information on the uses of wood in smoking meat was waiting for me when I returned to the office. The general principles of smoking as outlined in Farmers' Bulletin 1136, a copy of which was sent you, is representative of most of the printed information that we have at hand. Special flavors are credited to such woods as apple, maple and pecan, although most sections use the kind of hardwood that is available. That is the reason that some of the drier mountain areas smoke meat with the so-called mountain mahogany and in some sections of the Southwest the mesquite is selected.

Historically, it is believed that smoking was the means used to keep off flies and other insects during the time that strips of fresh meat, salted or unsalted, were drying in the sun. Grown accustomed to the appearance and flavor that the smoke gave the meat the custom has persisted even though insect protection is no longer needed.

Reports of the Food Industries Board, Cambridge England, imply that cured smoked fat becomes rancid in storage more slowly than the unsmoked.

If you are interested in the use of unusual woods for smoking meat it would seem that probably Professor Oliver or Mr. R. A. Lindgren might be able to report many such woods from areas in your own state where the unsuitable conifers are in such preponderance.

Very truly yours,

K. F. Warner,
Senior Extension Meat Specialist
Mr. Ashley A. Poust  
2019 Van Buren  
Corvallis, Oregon  

Dear Sir:

We are in receipt of your card of January 23 asking for a list of Department publications and books on the smoking of meat with wood. We are sorry to say that the Department has published little on this subject. Circular 187 of the Forest Service, Manufacture and Utilization of Hickory, by Charles F. Hatch, is practically the only one. This was published in 1911. There is a short statement in Farmer's Bulletin no. 1186 on this subject and we are enclosing a copy of this statement.

Very truly yours,

Associate Librarian.
The Fuel

Green hickory or maple wood is the best fuel for smoking. Hard wood is preferable to soft wood. Resinous woods should never be used, as they give an objectionable flavor to the meat. Corncobs may be used but they deposit carbon on the meat, giving it a dirty appearance.

From Farmers' Bulletin 1186, Revised, p. 19-20

Farmers' Bulletin 183 and 913 give the same statement.
Mr. Ashley A. Foust
2019 Van Buren Street
Corvallis, Oregon

Dear Mr. Foust:

We do not have in our records any information on the methods or processes employed by Indian tribes in the smoking of meats and fish.

There are an amazingly small number of older Indians employing the old methods of meat curing and it is apparent from the information obtained from the younger Indians, that authentic data can be secured only in historical records that can be found in most Museums of Indian History.

We attempted to secure information from some of the young Indians here, the attached result of the questionnaire bears out the fact that the Art of meat curing is fast becoming lost.

Very truly yours,

[Signature]

CGP:

Enc.
March 4, 1937.

Dear Sir:

In reply to your letter of February 8, I beg to say that we find no reference to the Indians using any particular wood in smoking meat and fish. It is probable that they merely used whatever material was readily available. For instance, the Shoshoneans of the Great Basin usually used sage brush or juniper.

There is no general work dealing with the processes of smoking meat and fish, and material on the subject could be found only be referring to the various ethnographies dealing with the northern tribes. You may be interested in the article "Pemmican" in the Handbook of American Indians, Bulletin 30 of the Bureau, which gives a brief description of the preparation of this food. The Handbook is no longer available for distribution but can probably be consulted in some large library near you. The preparation of pemmican is also described in "The American Indian" by Clark Wissler, published by the Oxford University Press, American Branch, New York, 1922.

Regretting that we can not be of more assistance, I am,

Very truly yours,

[Name of Administrative Assistant]

Administrative Assistant to the Secretary, S. I.

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Part II

Tannin Extraction

Economic Importance:

Chestnut and Quebracho form nearly 60% of all vegetable tannin materials. Yet the Quebracho is a foreign product while the chestnut is rapidly disappearing from the United States.

In 1904 the Chestnut blight was imported from Japan and China, and soon became a serious disease in New York. Since that date the disease has spread rapidly until at present it has killed 80% of all the available chestnut north of Virginia and penetrated Western North Carolina, eastern Tennessee and Georgia—the vital centers of the remaining stands of Chestnut timbers.

The effect of the blight from an economic point of view has not been determined, but it now appears certain that an estimate of our resources based upon an inexhaustable supply of Chestnut wood, must be subject to radical modification.

We are becoming more and more dependent on foreign countries for tannin materials. This alone should be a matter of concern to the leather industry in particular and the government in general, but when we consider our dependence upon foreign countries for our supply in the case of war, the importance of an adequate local supply assumes a much more serious aspect. With this in mind, I shall attempt to set down a few facts and figures gathered in my investigations as to a yet
untouched source of tannin material.

History:

Perhaps the first question that comes to the reader's mind is, "What is tannin and for what is it used?"

Tannins are substances which have the property of rendering animal skins strong, flexible, impervious to water and resistant to putrefaction, decay and wear. They are complex organic compounds with disputed structure and formula, but are known to fall into one of two chemical classes, called pyro-gallols and catechols. A further discussion of the chemical structure and composition is unnecessary here.

There are of course, synthetic tannins made from chemicals but so far they have not been proven entirely satisfactory.

All tannins have a varied color and strength depending upon the source and method of extraction, but they all have an astringent taste and have the properties of precipitating gelatin from solution and of combining with the protein matter of hide fibers forming a compound resistant to washing.

The principle use of the tannins is in the tanning of leather. However, they are used in the manufacture of inks, dyes, medicines and chemicals of different kinds.

The actual chemical cause of hides tanning to leather was never known until the 19th century. It was known, that certain wood barks produced the desired effects upon hides to make them useful as leathers, as early as 1000 B.C. This discovery was made by the Chinese.
Species and percent of tannin:

Tannins are found in small quantities in almost any plant, shrub, or tree. Commercially they are obtained from the hemlock, oak, sumach, chestnut, quebracho, gambier woods and barks, and certain nuts, leaves and gums of other plants. In the United States the chief sources are from the eastern and western hemlock, chestnut, mangrove, and oak barks. The relative percentages consumed in the United States are: chestnut extract, 47.6%; hemlock bark and extract 27%; oak bark and extract 23.3%; spruce extract 6%.

The gradual extinction of these sources from the eastern states leaves as a source the vast forests of western hemlock, red fir, and tan bark oak. The hemlock yields about 15.62 cubic feet of bark for every thousand feet of logs cut. In addition to this, the sawing process converts about 1.34 feet into sawdust. This gives a total of 17.56 cubic feet of bark for every 1000 bd. ft. log scale. The present hemlock stand on the Pacific Coast is estimated at 77 billion board feet. The total amount of bark available can be estimated as follows: 77,000,000 x 17.56 = 1,352,000,000 cubic ft. (approximately). The amount of bark available after sawing: 77,000,000 x 15.62 = 1,202,000,000 cubic ft. Similarly for the second growth Douglas fir, which is almost the same as hemlock in tannin content. The yield of bark is 17.42 cubic ft. per 1000 bd ft of log cut and 2.29 feet of sawdust. Estimate of bark based on the present estimate of 382,000,000 x 17.42 or approximately 6,654,000,000 cubic feet. The amount
available after sawing would equal \(382,000,000 \times 19.71\) or approximately \(7,5\bar{8}9,000,000\) cubic feet. \((17.42 + 2.29 = 19.71.\) As to the tan bark oak the resources are almost unlimited. According to the Forest Statistics published by the Forest Service there are \(433,434,000\) board feet of tan bark oak in Curry county alone.

Method of gathering and extraction:

The bark may be obtained in one of two ways; it may be peeled from the trees in the forest when they are felled, or it may be chipped from the logs as they enter the mills. The latter method is not desirable if the logs are transported in water, due to the tannins dissolving in the water. Which ever method is used, however, depends upon the location, labor and facilities for handling. Where transportation facilities are not of the best, the bark must not be looked upon as a waste product for in such cases it may be profitable to extract the tannin—the transportation of which presents less difficulty. I am submitting a sample of the dried extraction from tan bark oak in order that the reader may see what a minor problem in transportation this form would entail. This extract can be employed for tanning with the same result as bark itself, since 100 parts of extract are quite as efficient as 400 to 500 parts of bark. It follows that its higher commercial value allow it to be delivered to the consumer at far greater distances than is the case with bark. The extraction process furnishes the proprietors of forest lands with a means of bringing the one
valuable constituent of bark, i.e., the tannin, into such a form that it can be delivered at great distances while the extract affords the tanner the immense convenience that he is able to work with a rapidly prepared solution.

The best time for peeling is in the early spring, when the bark is easily removed and at this season contains more of the tannins. After the bark is separated from the wood it is dried to relieve it of the excess moisture. They drying may be done either by natural or artificial means. This step may be followed or preceded by the chipping of the bark which is necessary for complete extraction. The chipping is done in "hogs" which chip or grind the bark to a suitable size for use in the extraction tanks.

There are three methods of extraction in common use; the open diffusion, decoction and percolation. In the first method wooden tanks 16x20 feet in diameter and 12 feet in height contain the chips. The liquor is heated by steam coils or perforated steam pipes under the false bottom of the extractor. When direct steam is used, allowance for dilutions resulting from condensation of steam must be made in the quantity of weakest or "tail" liquor introduced. The liquor is continuously pumped forward from extractor to extractor, the wood being immersed at all times. This process requires from 2½ to 4 days from fill to empty.

In the second method, water is added to the extractor and boiled while the wood is immersed in it, and the resulting solution withdrawn. This process is usually carried on in batter-
ies of 10 extractors or leaches, and in practice a leach is filled with nearly saturated liquor, heated and the wood kept immersed until the strongest saturation possible of the solvent matter occurs. The time for the extraction in this process is 24 hours.

The percolation method consists of sprinkling boiling water over the wood in an extractor and the resulting solution is collected at the bottom and drained away. The wood is first steamed so the chips will settle to the bottom of the tank uniformly. The boiling water is admitted at the rate of 2.5 gallons per hour per square foot of area. This process requires about 24 hours for complete extraction.

There appears to be about 23% total soluble material in the bark. The proportion that can be extracted depends on the amount of water used, and the length of time that is allowed and also on the number of successive portions of water that are used. In general, it would not be commercially feasible to get out all of the soluble material because the last solutions would be rather dilute and the subsequent cost for evaporation would be out of proportion to the value recovered. Something like 17 or 18 percent soluble material might be obtained from the original bark.

Commercial feasibility of an extraction plant in Oregon:

At the Albany Tannery they pay $16 for 2400 pounds of bark, which means that they are paying about $60 per ton for what they can extract. The current quotations on the New York market for oak bark liquid extract, 25% solids, is 3½ cents per pound in barrels. This corresponds to 14 cents per pound or $280 per ton
for the dry material.

On the basis of some rough assumptions as to the cost of plant and equipment, it was found that the total cost of dry extract would be about $150 per ton. This was for a plant working 200 days a year and handling a total of 220 tons of bark.

The market for tanning extract is highly competitive, and it is probable that the figure of $280 per ton as quoted on the New York Exchange represents only a reasonable margin of profit on a commercial scale. So long as the tanneries are paying only $60 per ton delivered, using the Albany tannery as a general indication of going prices, it appears doubtful that anyone could afford to engage in the business, at the present at least, of producing either a concentrated liquid extract or a dry extract. However, investigation might reveal a potential market in the Orient and with such a large supply of raw material close at hand, another income producing industry might be developed in Oregon. From a study of the problem it appears quite obvious that there is no reason why it is necessary for the United States to be importing such a large amount of vegetable tanning when Oregon and Washington alone contain a veritable store house of tanning material.
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