Preservation and Storage of Wild Game Meats and Birds
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INTRODUCTION

These Guidelines provide instructions for the processing of meats of game animals and birds hunted by hunters at different locations. They also address ways to harvest and properly preserve meats in a manner that meet food safety requirements, through reduction of spoilage and damage caused by contamination, and therefore, ensure the health and safety of consumers. This can be achieved through the provision of advice and useful information for the amateurs of hunting, in order to avoid troubles notably due to the lack of experience and hence ensure their personal safety and the safety of meat produced from hunted animals. On a local stage, the lack of guidance material in this field serves as further incentive for the preparation of these guidelines, especially owing to the fact that most of the food safety legislations and guidelines pertaining to sound food and meat trading are linked to the meat obtained under ordinary circumstances from domesticated breeding stock at specialized facilities like animal production farms or Livestock markets. They are also associated with their slaughtering and processing procedures and controls at the abattoirs, slaughterhouses and sales outlets across all stages of a food chain.

In preparing the scientific material in these guidelines, a number of UAE national specifications, scientific references and relevant local legislations were used. This includes the guides of practices issued by the Abu Dhabi Food Control Authority (ADFCA) in relation to the general basics of food safety. Aspects directly related to the proper preservation and processing of meats were included within the text of the guidelines.

Furthermore, these guidelines briefly address the requirements of preventing diseases common to man and animals – zoonosis – in order to protect hunters from the hazard associated with these diseases during the processing of carcases, harvesting of meat, and preparation of products (Annex 1). This was necessary due to risk of exposure to zoonotic diseases in different game-hunting areas around the globe.

PURPOSE

These guidelines aim at the following:

a- Offering directives and technical support to wild-game hunters in the Emirate of Abu Dhabi and explaining the necessary steps to be taken for the processing of carcases, which should be based on good health practices and food safety basics?
b- Explaining some general practices for the prevention of diseases common to man and animals (zoonotic diseases) and food-borne diseases which hunters are at risk of contracting.
c- Addressing some methods used in preparing and preserving meat generally and which can be capitalized on in preserving game meat after moving the meat from the hunting area to the hunters’ camps where there is increased availability of equipment, tools and material required to this end.
d- Addressing freezing and refrigeration methods and steps, after obtaining the meat or separating it from the carcase, as a key element for extending the preservation period, hence ensuring the safety of consumers.

DEFINITIONS:

For the purposes of these guidelines, the following terms and expressions shall have the meaning ascribed beside each, unless the context shall indicate otherwise:

Wild Game animals: animals hunted for their meat, using several methods like firearms or trained animals

Curing: means the preservation of meat from spoilage. Curing is typically effected using two methods: dry curing and wet curing. Dry curing is effected by the addition of sodium chloride in high concentrations and some meat flavoring agents. Wet curing, on the other hand, is effected using saline solutions (curing solutions) by deeply injecting or pumping them into meat cuts.

Pickling: placing the meat, after injecting it with saline solutions, in another solution in a suitable rust-resistant metal container that should be prepared prior to placing the meat directly in the container

Drying/Jerking: placing cooled meat slices, after the addition of salt and cutting the meat on a clean surface made of rust-resistant metal and then exposing the meat to heat at a maximum temperature of 48 °C in a convection oven. The heat is turned off before the meat becomes firm and hard.
Canning: means exposing the meat to heat using a pressure canner for a time sufficient to kill pathological bacteria. After processing the cuts of meat and removing excess grease, they are placed in a water containing one tablespoon of table salt (common salt) per each gallon of water. The meat (on the bone or deboned) is then cut in a way that suits the dimensions of the container.

Smoking: exposing meat to wood smoke using numerous methods, until the meat dries out, with the aim of preserving the meat while lending an exquisite flavor and appearance at a temperature of minimum 48 °C roughly, using adequate types of dry wood (e.g. oat), to prevent any unwanted taste. Smoking may continue until the internal temperature of meat reaches 70 °C.

Aging: keeping the fresh, marinated or smoked meat under controlled conditions in terms of heat and moisture in a clean place where temperature ranges from 3 to 7 °C typically for several days or sometimes more, depending on the amount of moisture to be eliminated until the internal chemical reactions and changes of the meat are completed. This aims at increasing the tenderness of meat, or adding a special flavor by adding some fermentation materials.

Thermometer: a thermometer is a device that measures temperature and is used to measure the temperature of conserved meat or meat exposed to heat or otherwise the effectiveness of refrigeration means.

Seasoning: improving or modifying the taste of meat by adding salt and spices basically (ground pepper) in specific amounts.

Zoonotic Diseases (Zoonoses): diseases that are transmitted between vertebrate animals and humans.

Food-borne Diseases: any illness transmitted to humans from the consumption of contaminated food, including meats, and zoonoses.

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora
An international agreement that establishes controls for the trading of endangered animal and plant species.

1. CHARACTERISTICS OF WILD GAME MEAT

Wild game meats are characterized by the following:

a- The same nutritional value as other types of meat obtained from ordinary sources like domesticated species (livestock and poultry), which constitutes an added multi-source nutritional value that benefits the nutrition of humans. Nevertheless, special steps must be taken in processing such meats, for they are obtained differently through hunting in wild, unpopulated areas where required facilities are not available.

b- Lower fat content and high protein content. Moreover, the quality of game meats is influenced by the prompt cleaning process and means of preservation, be it by refrigeration and freezing or otherwise, after hunting them, given the natural spread of contaminants in the hunting area or in animals themselves, including harmful bacteria like Salmonella and Escherichia coli.

c- The quality of game meats is affected by the effort for escaping exerted by game animals while being chased, before hunting them. Therefore, game animals do not bleed after being slaughtered like animals which are slaughtered under ordinary conditions, which result in higher amounts of blood remaining inside game animals, and hence a lower amount of glycogen. Glycogen serves as a source of energy in muscles, which lowers their resistance to damage and spoilage and quality preservation, as compared to regular meat. With this in mind, game meats are subject to fast deterioration unless the necessary precautions are taken. It is therefore paramount to check the safety of meats and their proper processing, if abattoirs can be found in the hunting area and meat can be transported to such abattoirs without hardship.

2. REQUIREMENTS FOR THE PRESERVATION OF HEALTH AND PREVENTION OF ZOONOSIS DURING WILD GAME HUNTING

For those who organize wild game hunting activities, they should start by collecting information on the area where they wish to conduct their activities prior to going on hunting trips. They must first inquire about the health status of animals and epidemics among animals, as well as zoonosis that are transmitted.
from animals to man directly, or through the processing of diseased carcasses or otherwise the consumption of meats and meat products. Also, they should obtain adequate information from the competent veterinarian authorities in the country before the trip.

There are a number of diseases that pose a risk to the health of hunters and that are spread in specific countries around the world like the Crimean Congo Hemorrhagic Fever, a viral disease transmitted from ticks (Fig. 1) or spread to hunters following exposure to the prey’s fluids. In Eastern Europe, India, the Middle East and Africa, the Rift Valley Fever is caused by a virus transmitted by mosquitoes and which is spread in the Arabian Peninsula and Africa (Fig. 1), in addition to a number of other serious diseases (Annex 1).

The precautionary steps that must be taken to prevent the contraction of such diseases or keep the country free from animal diseases transmitted through products, include the following:

a- Learning about the epidemic situation of animal diseases in the relevant hunting area

b- Consulting with the appropriate veterinary authorities about the use of some animals (e.g. hawks and saluki dogs) as a hunting tool to ensure these animals are suitable to use and are disease-free.

c- Abstaining from hunting when the hunter is not in a good health status such as contracting any transient illness after arriving in the hunting area, because of potential low immunity and possibility of contracting infection with some pathogens.

d- Taking the precautions necessary to prevent insect stings in the hunting area.

e- Avoiding hunting wild animals or birds showing abnormal signs (e.g. wasting disease, diarrhea, ticks and sarcoptic mange) (Fig. 1).

Figure (1): some disease-carrying external parasites, some of which causing skin diseases like sarcoptic mange
Figure (2) wearing gloves during the processing phases and while handling carcasses is paramount necessity for the prevention of zoonosis, food safety and the preservation of meat from contamination and quick spoilage.

f- Abstaining from eating, drinking, smoking or otherwise using cell phones (mobile phones) while cleaning and processing hunted animals and birds

g- Wearing protective clothing such as gloves while handling carcasses for processing at the site (Figure 2)

h- Abstaining from using the same pots for the processing and cleaning of different types of animals and birds and replacing or washing such pots well and sterilizing them after each processing of different types of carcasses.

i- Removing old injuries from the skin of game animals, if any, especially if meat was contaminated by pus, and removing the injury spot and the entire contamination

j- Disposing of carcasses, if specific abnormalities are found especially in the chest area and abdominal cavity, or if there is foul smell in the contents of the digestive tract or otherwise in the presence of blood clots that are not associated with the hunting and killing of preys.

k- Limiting exposure to the tissues of the nervous system of the animal (e.g. brain and spinal cord) when separating meat from bones, especially in the head area during processing and ensuring they are not subject to cutting. Also, the skulls of animals with horns showing abnormal signs may not be broken and horns should be removed from the skull by means of a proper hand saw in other game animals, as well as ensuring the face of those who perform such removal is protected (Fig. 3).

l- Shots should not be fired towards the belly area of the animal to spare the animal any unnecessary suffering and to prevent the contamination of meat by the contents of the digestive tract, in which case meats should be disposed of.

m- Washing the hands, tools and devices used properly with water and soap or alcohol-based disinfectants after finishing work.

n- Avoiding the consumption of game animals’ raw meat or meat that was not exposed to adequate heat to reduce the contraction of food borne diseases. Therefore, the meat of game animals should be subjected to a
temperature, normally in the range of 65.6-82.2 °C for sufficient time as to allow the release of fluids from the meat. During this process, the pinky color of fresh meat changes (depending on the nature of the animal’s meat). On the other hand, the meat of birds should be exposed to a temperature of 73.9 °C for a sufficient time.

- The freezing (or refrigeration) of uncooked meat should be effected as promptly as possible. Cooked meat shall be fully separated from uncooked meat, so as to avoid any accidental or unintentional contamination.

p- Refrigerating the meat promptly and avoiding keeping it at room temperature for a long period of time, refrigerating meat and lowering the meat temperature may prevent any alteration in its characteristics, but not necessarily the spread of contagion if the meat was contaminated from the start and no sound methods to prevent contamination were employed.

3. PRESERVATION OF MEAT SAFETY AFTER HUNTING

The safety of wild game meat intended for consumption depends to a great extent on the awareness of hunters and game meat dealers and their commitment to the good health practices and adherence of food safety basics, as well as on the employment of sound meat conservation methods similar to the procedures adopted for other types of meat. It should be noted, however, that the surrounding conditions of hunting are different, it is therefore of paramount importance to be cognizant of the types of animals spread in the hunting area and to avoid the species forbidden under the Islamic Shariaa, in addition to employing the method recommended in Islam during hunting (Annex 2) and abstaining from hunting prohibited animals under international agreements (CITES) pertaining to the protection of endangered species. Lists of these animals can be obtained from the competent authorities like the Ministry of Environment and Water.

The major good practices that should be observed while processing game meat to ensure it is safe for human consumption are as follows:

1- Cleaning and washing hands with water and soap properly prior to commencing the processing of carcasses and when moving from one activity to another during and after the processing phases, as well as anything that could result in any contamination.

2- Commencing work using clean tools and containers and washing and cleaning them regularly before and after each use.

3- Washing and cleaning tools like knives (Fig.4), tables, and cutting boards, crushing tools and devices used to remove horns like saws, axes or cleavers (Fig. 3) after each use, with hot water at 82 °C (thermometer to be used) or cleansing them with disinfecting solutions. It is advisable to use water containing chloride compounds (one tablespoon of the concentrated solution per gallon or four cups of clean water) or place them in a suitable container that contains disinfecting solution (after processing it at the mentioned rates). They should be left to dry in the air. It is also advisable to prepare an adequate amount of disinfecting solution to be ready for use during the hunting trip.

4- Meat should be placed at a sufficient distance from other foods while preparing meat for preservation. It is advisable to use differently colored cutting boards for meat to avoid their use with other foods.

Figure (4) Examples of knives and cleavers required for skinning and cutting
Figure (5) the need to use clean cutting boards and to wash and clean the hands, knives and cutting boards before and after each use.

Figure (6) Example of a meat cutting table, particularly useful in the cases of large-sized carcasses

4. TOOLS AND EQUIPMENT REQUIRED

For proper processing of carcasses and meats at the site (hunting site), necessary equipment, containers and materials should be available for the processing and cutting of meat. Additionally, it is important to use the materials that prevent the spoilage of meat obtained from different types of animals, whether they are large or medium size, like deer or small size like birds. It is necessary to have, as part of the hunting team, people who possess the qualification and experience needed prepare and process carcasses using sound methods, and preserve and package such carcasses in a way that ensures proper cooling or freezing should be available within the group of hunters. This would help with the preserve the meat for relatively longer periods of time after hunting.

For the proper preparation for the extraction of meat from carcasses, especially large-sized carcasses, specific tools and equipment should be used, notably including: (Fig.4)

a- Sharp knives and tools for the sharpening of knives, like those used usually by butchers (Fig.4)

b- An adequate number of axes, cleavers of small saws or similar equipment (Fig.3)

c- Robust vertical carriages and horizontal bars made of solid materials, which can be properly fixed for suspension purposes, as well as plastic ropes or ropes made of suitable material with length equivalent to, or slightly less than, 8 m thus providing adequate rigidity for the suspension of animals (Fig.12)

d- Ring cords made of suitable substance like rubber to tie up the ends of the digestive tract when extracting it (to prevent any leakage of contents from the digestive tract and thus any contamination of meat)

e- Hooks to hang some parts of the carcass. Hooks may also be used to pull out the intestines from the cavity of large-sized carcasses (Fig.9 and Fig.10)

f- Cutting tables and boards which should be easily washed and cleaned and resistant to breakage and splitting. (Fig.5 and Fig.6)
g. Adequate amounts of the following materials should be provided for the intended purpose:

1) Plastic gloves of different sizes (Fig.2)
2) Sterilized paper towel boxes
3) Nylon bags that can be firmly closed and available in different sizes (Fig.11)
4) Clean mild cloth used to wrap the meat, if freezing is contemplated.
5) Table salt and spices (like ground pepper)
6) Clean water and crushed ice
7) Thermometer that should be used to measure the temperature of cooked and uncooked meat (Fig.8). It is also useful in estimating the effectiveness of refrigeration means
8) Thermal insulation boxes to refrigerate meats after wrapping them, using ice (Fig 28 and Fig. 29)
9) Washing and disinfecting materials

Figure (7) Cutting boards and knife disinfecting device

Figure (8) Use of Thermometer on the deep layers of meat to measure the temperature of the deep layers of poultry carcasses and to check the internal temperature even after cooking

Figure (9) Hooks used in the vertical hanging of animals

Figure (10) Hooks used to pull out the intestines of large-sized animals
5. PROCESSING OF ANIMALS AT THE HUNTING SITE

For the proper processing of animals at the hunting site, the following shall be performed:

a- Hunters should promptly process and extract the meat and transport it for frozen storage, for this constitutes the major step to ensure the safety and quality of meat by lowering the potential for contamination and spoilage and slowing the proliferation of bacteria.

b- Preserving the carcasses of birds and small-sized animals as an entire carcass (after removing the intestines). Large-sized game animals (e.g., bullocks or larger) require the separation and cutting of smaller parts into four portions or less, unless storage boxes with adequate capacity are available (Fig. 27 and 26).

c- When hunting large-sized animals, it is recommended to approach the animal, after falling down, from behind to ensure the animal is unable to move and then control and slaughter it if still alive, to ensure the highest possible bleeding. Also hunting experience, like firing shots thoroughly into the neck, would allow for the highest possible bleeding and thus the prompt death of the animal prior to reaching and slaughtering the animal, and thus the prompt death of the animal after losing the highest amount of blood.

d- Dragging game animals out of muddy or contaminated areas to a relatively dry and clean place prior to skinning and removal of intestines while keeping the head and neck. Temperature of wild game animals should be promptly altered to preserve the quality of meat. The loss of temperature may be accelerated by swiftly opening the chest and bell cavities. A clean tool in the form of a stick may be used to keep the cavity open.

e- Using clean water to wash the parts contaminated by sand, clay or grass as promptly as possible.

f- Carcasses should be attached by one hind leg and hung on bars or carriages properly fixed as carriages for hanging, using plastic ropes so that they would be hung in an upright position as shown in Fig.1.

g- Contamination of meat during the skinning, emptying of intestines or cutting process should be avoided

h- It is critical to wear clean gloves during work and replace them or clean them after each use.
Figure (13) Hunting using trained dogs (saluki) and some practices that should be avoided, like placing meat on the ground without taking the precautions required, which would result in the contamination and quick spoilage of meat and threaten the safety of both the meat and consumer.

Skinning may be accomplished by cutting the skin in a line parallel to the center line of the carcass, starting from the breastbone (Fig. 14) through the udder area or testicles, while pointing the head of the knife and sharp blade to the top to cut the skin towards the outside of the carcass in order to avoid penetrating the stomach or intestines and leakage of their contents into the meat.

Figure (14) the Right Path for the Cutting Process during the Skinning of the Carcass

Figure (12) Eating game animals at hunting sites in vertical position is common and processing may be affected on the floor if necessary while ensuring the non-contamination of the carcass.
j- The rectum should be tied off by producing a round cut from the outside around the opening of the anus through rubber rings or other appropriate tools to avoid the spread of rumen contents onto the cavity of the carcass. The esophagus can be tied off in the same way to avoid the spread of stomach contents onto the cavity of the carcass.

k- With the support of another person, intestines should be pulled out through the cut opening. Then, the barrier separating the chest cavity from the abdominal cavity can be reached and the trachea can be cut off and the esophagus cut off and pulled out above the place of attachment along with the lungs and heart.

l- After pulling out the intestines, blood and fluids cumulated in the cavity should be taken out.

m- In cold weather conditions, if one is compelled to start by emptying the intestines quickly before skinning (Fig. 16) due to the difficulties associated with this activity, the carcass should be exposed to proper ventilation to preserve the meat from spoilage due to the ability of the carcass to maintain its temperature in case it was not promptly skinned.

n- In hot weather conditions, the cavity of the carcass should be filled, after emptying it, with ice-filled bags and then closed with a thread prior to moving it to the place where work should be completed.

6. PROCESSING OF RABBITS

a- Precaution should be taken when handling game rabbit meat to avoid contraction of tularemia. This can be done by adhering to sound health precautions by wearing gloves and protective clothing and using clean water when washing meat, as well as disinfecting the knives regularly.

b- During the processing of game rabbits (Fig.15), they should be skinned and the carcass should be opened from the bottom and suspended by the hock joint (tarsus). The tail should be removed and the skin should be cut off at the level of the other hock joint, near the tail base through the suspended leg. After cutting the edge of the skin, it should be pulled down to remove it completely. The carcass should be opened up from the breastbone to remove the intestines and lungs. Finally, the carcass should be washed thoroughly with clean cold water.

Figure (15) Hunting, Skinning and Processing of Rabbits

Figure (16) Hunting of bustards through trained hawk and processing the bird after hunting Processing of small preys like game birds

There are several types of birds that are hunted for their meat in many countries. Information about on the areas where they can be found and spread and distribution of these birds, as well as the relevant hunting controls can be obtained from the competent authorities in such countries. Among these birds are bustards (Fig. 16), wild turkeys, quails, guinea fowls and ducks.
7. PROCESSING OF SMALL PREYS LIKE GAME BIRDS

Birds are properly processed at the hunting site, by taking the following measures:

a- Prompt processing of birds to prevent the proliferation of bacteria in their meat (Fig. 16), since game birds are susceptible to spoilage from contamination by bacteria in the hunting environment, including disease-causing bacteria.

b- Providing and using the equipment required for work and for the processing of bird carcasses, like gloves, knives and skinning and cleaning tools, as well as cutting boards and suspension ropes, in the case of large-sized birds such as turkeys.

c- Emptying the intestines of the bird by placing the carcass on its back, opening the skin by stretching the area above the breastbone and producing a linear cut through the end of the carcass and between the hind legs, and then pulling the intestines out by hand. Care should be taken not to tear or puncture intestines and thereby allow the spread of contents onto the bird cavity.

b- Removing the craw (part of the digestive tract where food is stored before passing to the stomach)

e- Removing the craw (part of the digestive tract where food is stored before passing to the stomach) by incising the neck down to the upper chest where the craw is located. Care should be taken not to tear or puncture the intestines or other organs.

f- After pulling out the intestines, heart and lungs, the area around the opening of the rectum should be pulled out carefully.

G- Cleaning the bird’s abdomen after removing the craw and other internal organs by disposing of the fluids contaminated with blood using clean water then hanging the carcass in order to expose it to air circulation and dry quickly.

h- The bird should be cleaned of external dirt and the entry of gunshot if used

i- Eatable organs such as the liver and heart can be placed and preserved in a plastic bag and lower parts or feet in addition to the lower part of the thighs' joints should be removed and disposed of.

j- The used tools should be cleaned regularly during the work, and gloves should be replaced between the different stages of work. Knives should be disinfected with alcohol wet wipes for instance and cutting boards should be cleaned when necessary during the work and with warm water and disinfectants upon finishing.

k- Ice bags shall be placed in the abdomen of the birds. In case of large numbers, birds should not be stockpiled in the cooling box, instead they should be placed in the cooling box as soon as possible and a distance should be kept between the birds to allow air circulation.

l- For feather-plucking, paraffin wax can be used if available; otherwise the birds should be submerged in a 55 °C hot water for a period of no more than 60 seconds before feather-plucking.

m- In case the internal organs smell bad or look greenish, or in case the blood is black, or in case blood clots are found in the muscles, the carcass should be considered unfit for consumption and must be disposed of.

8. VETERINARY INSPECTION OF GAME ANIMALS AT THE SLAUGHTERHOUSES LOCATED NEAR THE HUNTING AREAS:

a- When a slaughterhouse is located near the hunting area, it is advised to send the carcasses of wild game animals are veterinary checked processed at the slaughterhouse, provided that the carcasses are well preserved by by prompt refrigeration upon hunting to avoid exposed to rapid change.

b- The initial veterinary check on the carcasses at the slaughterhouses is usually done based on the expected risk level in order to exclude and prevent anything that may contaminate the slaughterhouse environment. The inspection includes looking for any distinctive obvious signs of some infectious diseases or impurities, taking into account that some carcasses may be brought to the slaughterhouse with incomplete parts.
c- All the proper health procedures required, e.g. cleaning the carcass of any impurity factors, should be applied, in addition to the regulatory procedures stipulated by the competent in relation with the inspection of carcasses, e.g. linking the internal organs with the relevant carcasses.

d- Any information about the hunting area environment that may affect the safety of the carcasses should be taken into account and should be shared among the hunters for the purpose of guidance, and to ensure they follow the proper practices to ensure the safety of wild game animals’ meat.

e- Inspection-like procedures are taken before the routine slaughter done for ordinary carcasses; however these procedures are limited and focused on detecting abnormal signs on the body of the wild game animals such as signs of death before getting slaughtered or signs of any diseases. Then a detailed inspection is done to the other parts, i.e. post- slaughtering inspection to determine if the meat is safe for consumption.

f- The same steps should apply to the case of other animals and standard slaughter at slaughterhouses in order to identify and number carcasses and their parts during and after the stages of processing. The refrigerators and freezers available at the slaughterhouse can be used to preserve wild game meat when necessary.

9. PRESERVATION METHODS THAT CAN BE USED IN THE CASE OF WILD GAME MEAT:

There are many methods that have been known for years for preserving meat for long periods and that can be applied in camps to preserve the wild game meat after hunting for future consumption. Most of these preservation methods consist of using table salt (sodium chloride) or exposing the meat to heat, or both, in order to get rid of the moisture and stop the growth of germs (bacteria and fungi). The same meat cuts can be handled with more than one method to ensure good preservation. For instance curing can be followed by pickling or smoking (exposing the meat to smoke emitted from the combustion of certain types of wood) and thermal drying can be followed smoking. In order to apply any of the preservation methods, the requirements of such methods, e.g. materials and tools in the hunting camp in addition to the cooking skills and experience are necessary. In fact, these methods are very important especially in case refrigeration and freezing methods are not available to preserve meat. Below are some key methods to preserve meat:

a- Curing
b- Smoking
c- Pickling
d- Drying / Jerking
e- Canning
f- Aging

Below is a brief explanation of the key practical steps for these methods:

A. CURING

1- Curing is done after the meat is cleaned and refrigerated in two ways: the dry method by using salt and sugar (30 grams of salt and 15 grams of sugar per kilogram of meat), or the wet method by injecting the meat with a saline solution (prepared of 1kg of salt and 0.5 kg of sugar for every 1 gallon of pure drinking water); however it is advisable to buy commercial ready solutions for this purpose.

2- The saline solutions should be injected in the meat cuts with a multi-hole hollow needle. It is necessary to avoid causing air pockets due to improper injection.

3- The aim of the injection (Fig. 17) is to distribute the preserving saline solution in the meat deep tissue, as injection helps in distributing the saline solution in two directions: in the deep layers at the beginning of the injection, gradually until the external layers while removing the needle. This means that the saline solution is distributed in two directions: from the inside (deep layers) toward the upper layers and at the same time from the surface layers towards the deep layers while removing the needle at the end of the injection process. This results in an equal level of the solution saline in the meat cut.
4. The injection tool should be cleaned between the different uses with soap and disinfectants, and should not be exposed to dirt and impurities. During the injection process, the needle should be filled with the solution which should be slowly injected by inserting the needle in the meat. It is necessary to prevent leaving any air bubbles when filling the needle with the solution.

5. 3–4 20 ml injections are usually needed to inject 3–4 times the hind legs, which weigh 5–7 kg, 5–6 injections are needed for the larger parts weighing 7–12 kg, and 1–2 injections are enough for the smaller parts.

6. After the injection of the meat with the saline solution, dry curing is done by rubbing the meat with a saline powder, especially around the bones and joints areas (hock and knees). The powder usually consists of 25 KGs and 1Kg of sugar and small amount, about 4 spoons, of Sodium Nitrate and 1 spoon of Sodium Nitrite for every 50 KGs of meat.

7. The meat should be placed uncovered on a flat surface at a temperature of 3 - 4 °C for a period of 4-6 weeks.

8. After the dry curing process is completed, the meat can be marinated in warm water for 30-60 minutes, and using a clean brush, any remaining fat can be scraped off of the surface.

B. SMOKING

1. The cured, pickled or dried meat is smoked at a temperature of no less than 48 °C. The smoking process aims at giving the meat a distinctive flavor by using special types of dry wood for smoking to prevent any undesired change in the taste (Fig. 20).

2. The smoking process should continue until the internal temperature of the meat (measured by a thermometer) reaches 70 °C.

3. In order to preserve it for a longer period, the meat can be frozen. The smoked meat should be wrapped with clean mild cloth.

C. PICKLING

1. The meat can be placed after injection in a saline solution. The meat injected with saline solution (as described above) is placed in a suitable stainless steel container, provided that the saline solution is prepared right before placing the meat in the container. In case no scale was available to measure the ingredients of the solution, the sugar quantity should be 50% of the salt quantity.

2. The meat should be placed at 3°C for a period that estimated as a week for each one Kg. the solution should be changed upon the change of its color.

3. The meat cuts can be exposed to smoking after the process is completed.
D. DRYING THE MEAT BY USING SPICES AND FLAVORINGS

1- The meat shall be cleaned first by removing fat and impurities, and then it shall be immediately refrigerated at a temperature of 3 - 4 °C.

2- Proper quantity of spices should be added: 300 grams of salt (5 tablespoons) + 150 grams of sugar (2.5 tablespoons) +15 grams of spices or ground peppers (2 teaspoons), (Fig. 18).

3- The meat can be dried thermally or by smoking after seasoning in case a certain flavor is desired.

Figure (18) – Seasoning meat with spices by adding preservative spices (ground pepper and salt) for preservation and drying

E. CANNING

1- Canning is done with a pressure canner to expose the meat to the proper temperature for long enough to eliminate pathogenic bacteria. The meat should be clean and free of any dirt and impurities. Several types of birds, large and small animals’ meat are preserved this way.

2- The cuts of meat should be placed after processing in water salted with a tablespoon of food salt for every ¼ gallon of water. The excess of fat should be removed and the meat should be cut with or without bones in a manner suitable for the container where it is going to be preserved. For this purpose two methods are used:

Figure 19 – Canning meat in containers for a period before consuming

2.1- The first method consists of exposing the meat to heat until it is only 2/3 done. Water should be placed in a container with one tablespoon of salt for every ¼ gallon of water, then the cuts of meat to be preserved should be marinated in the broth resulted from the boiling process, provided that the containers are not fully filled (Figure 19).

2.2- In the second method, the meat is preserved without being boiled, by placing the meat in the container, adding the salted water (prepared as mentioned above) and tightening the lid. After that, the meat is exposed to pressure for 1 – 1.5 hour or as per the instructions of usage of the pressure canner.
F. JERKNING / DRYING

1- It is the process of exposing the meat to heat for drying after cutting the same in long segments of suitable thickness then preserving the meat at a temperature of 3 - 4 °C. The meat should be placed after being cured on a clean surface of stainless steel.

2- An oven can be used for exposing the meat to a temperature of not less than 48 °C. In order to improve the oven’s capacity of drying, hot air circulation should be available.

3- Appropriate types of timber should be used for smoking meat as desired.

4- Exposing the meat to the heat for drying is stopped (Fig. 22) by removing the meat from the place where it is exposed to heat before it solidifies. The weight of meat generally decreases by 50% after smoking.

5- After that, the dried meat should be stored by placing it in clean plastic containers or covering it with mild cloth then freezing it. The meat should be checked at the beginning of the storage period to make sure of the drying quality. Although jerking can preserve the meat for long periods and in different temperatures, the quality of the meat can decline within months.

6- For drying small animal meat, e.g. deer or goats, meat should be deboned and muscles should be cut in large slices that are injected with a previously prepared saline solution. Then, meat should be fully marinated in a saline solution and stored at a temperature of 3–4 °C for 10 days. Meat cuts should be turned every two days then smoked at a temperature of 65 °C and exposed to open air to dry gradually at room temperature for two weeks. After that, meat can be consumed directly or spices can be added as desired.

G. AGING

Aging is preserving or storing fresh, cured or smoked meat (Fig. 22 & 23) in suitable conditions in a cool, clean place, where temperatures do not exceed 3-7 °C typically for several days or sometimes more, depending on the amount of moisture to be eliminated until the internal chemical reactions and changes of the meat are completed. The purpose of the aging process is to complete the change processes and internal chemical reactions that occur during different curing processes in order to give tenderness to the meat, improve its texture.
and concentrate its flavor by adding some fermentation materials. Aging is not important in the case of birds or young animals but is useful in the case of bovine animals’ meat. One of the key requirements for aging is the availability of the right place and equipment in terms of coolness and cleanliness.

Figure (22) – Using a mild cloth to cover the meat during the aging process

10. GENERAL GUIDELINES FOR THE PRESERVATION AND STORAGE OF WILD GAME MEAT BY REFRIGERATING:

a- It is necessary that the refrigerators and freezers used for the preservation and storage of wild game meat are easy to clean and free of any impurity (Fig. 24). The refrigerator and freezer shall be maintained clean even when they are empty and shall be cleaned with an antiseptic solution between successive uses.

b- The efficiency of the refrigerator shall be checked regularly in terms of air circulation and level of humidity. Meat shall be hung in an upright position and shall not be put on the floor (Fig. 25). The refrigerator or freezer’s temperature may be measured by a suitable thermometer, e.g. laser thermometer and should be lower than 4 °C for refrigerators or -20 °C for freezers.

c- To prolong shelf life without causing undesirable changes, meat shall be cooked or exposed to heat before refrigeration. The Meat’s internal temperature shall reach no less than 73 °C. Then, meat shall be immediately refrigerated at a temperature of 4 °C or frozen at a temperature of -18 °C.

d- The frozen meat may not be defrosted at room temperature if not cooked; it shall instead be defrosted inside the refrigerator.

e- In case the skin of the carcass is to be kept, it shall be processed with salt and left for a period of 24 - 46 hours to dry, then stored in a place allocated for that purpose.

Figure (24) – A sample of cooling refrigerators
11. GENERAL GUIDELINES FOR THE PRESERVATION AND STORAGE OF WILD GAME MEAT BY FREEZING:

Birds and wild game meat may be preserved by freezing immediately after hunting; however the quality and safety of meat shall be maintained by following the steps below:

a- It is advisable to take the decision to freeze the meat in advance without delay.

b- The hunted animal shall be skinned during the first few minutes of the slaughter. The stomach and the intestines shall be removed without any delay in order to avoid internal contamination. The guts shall be removed carefully to avoid the perforation of intestines or gall bladder and to avoid polluting the meat to be frozen.

c- The meat should be frozen as soon as possible while it is still fresh and in good condition.

d- The Cuts of meat shall be wrapped with a material of a nature suitable for preserving frozen meat.

e- The meat shall be wrapped loosely without leaving any spaces between the wrapping material and the surface of the meat. Air bubbles shall be removed as much as possible.

f- The meat shall be placed in a freezer of a temperature not exceeding -18 °C. The freezing period shall not be so long. Wild game meat may be preserved by freezing for up to one year and vacuum packaging helps preserve the quality of frozen meat.

g- Long-term storage to preserve meat by freezing for a period not exceeding one year shall be done at a temperature of -18 °C after cutting the meat in accordance with the specifications in force in the State.
12. THE TEMPERATURE REQUIRED FOR SAFE PRESERVATION AND STORAGE OF FOOD AND MEAT

Cooked meat shall not be consumed if exposed for a period of more than two hours to temperatures within the (danger zone), where pathogenic bacteria grow and multiply (between 5 and 63 °C).

RELEVANT DOCUMENTS AND REFERENCES:

   Code of Hygienic Practice for Preparation, Transportation, Handling and Storage of Fresh Meat

   Concerning frozen poultry and red meat

   Code of hygienic practice for meat

4. Standard Specification UAE.S / GSO 1931:
   Halal Food Part (1): General Requirements

5. The Relevant documents issued by Abu Dhabi Food Control Authority:
   • Code of Practice No (12) of 2011 on Slaughterhouses
   • Code of Practice No (13) of 2011 on Food Safety & Hygiene Guide to Catering Sector
   • Regulation No. 6 of 2010 on Food Hygiene throughout the Food Chain


7. Proper processing of wild game and fish, Penn. State University- College of Agricultural Sciences, Agricultural Research & Cooperative Extension.


Annex (1) Some key common diseases that can be transmitted by fishing in the affected areas

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
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</thead>
<tbody>
<tr>
<td>Anaplasmosis</td>
<td></td>
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<tr>
<td>Avian Influenza</td>
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<tr>
<td>Babesiosis</td>
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<tr>
<td>Brucellosis</td>
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<tr>
<td>Campylobacteriosis</td>
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<tr>
<td>Chronic Wasting Disease (CWD)</td>
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<tr>
<td>Cryptosporidiosis</td>
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<tr>
<td>Deer Parapoxvirus</td>
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<tr>
<td>Hydatid Tapeworms (Echinococcosis)</td>
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<tr>
<td>Escherichia coli Infection (E. coli)</td>
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<tr>
<td>Giardiasis</td>
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<tr>
<td>Hantavirus</td>
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<tr>
<td>Leptospirosis</td>
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<tr>
<td>Q fever</td>
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<tr>
<td>Rabies</td>
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<tr>
<td>Salmonellosis (Salmonella species)</td>
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<tr>
<td>Sarcoptic mange</td>
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<td>Tuberculosis</td>
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<td>Toxoplasmosis</td>
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<td>Tularemia</td>
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</tbody>
</table>

Annex (2) Non-halal animals that Islamic Sharia prohibits eating

<table>
<thead>
<tr>
<th>Description</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrestrial animals that are not slaughtered according to Islamic Sharia, or</td>
<td>Terrestrial Animals</td>
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<tr>
<td>that hath been killed by strangling, or by a violent blow, or by a headlong</td>
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<td>fall, or by being gored to death; that hath been eaten by a wild animal; or</td>
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<tr>
<td>that are impurity are considered non-halal and are forbidden in Islamic</td>
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<tr>
<td>Sharia.</td>
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<tr>
<td>Pigs, donkeys, mules, elephants, monkeys and the like.</td>
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<tr>
<td>Predators and the like, e.g. dogs, foxes, leopards, bears and cats except</td>
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<tr>
<td>hyenas.</td>
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<td>Birds of Prey with sharp talons and the like, e.g. eagles, vultures,</td>
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<td>hawks and crows, gledes and owls.</td>
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<tr>
<td>Rodents, reptiles, vermin and the like, e.g. mice, rats, centipedes,</td>
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<tr>
<td>snakes, serpents, varans, lizards, geckos, chameleons, hedgehogs, hooks,</td>
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<tr>
<td>and bats (except dabbs and gerbils).</td>
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<tr>
<td>Scorpions and all kinds of insects, worms and animals that the Sharia</td>
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<td>prohibits killing and the like, e.g. ants, bees, woodpeckers and hoopeses,</td>
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<td>with the exception of locusts and what cannot be avoided as parts of bees</td>
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<td>falling in the honey.</td>
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<td>Repulsive (bad) creatures and the like, e.g. snails and stages of larva</td>
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<tr>
<td>and other similar animals.</td>
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<td>Animals that have been fed impurities, unless hold and fed their permissible</td>
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<td>food according to the Shariias for a period not less than three days.</td>
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<tr>
<td>All amphibians and the like, e.g. crocodiles and frogs except for sea</td>
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</tr>
<tr>
<td>turtles.</td>
<td>Amphibians</td>
</tr>
</tbody>
</table>