

MOLECULAR GASTRONOMY



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WATER H₂O

- MAIN STRUCTURE OF LIVE BEING HUMAN 60%, MEAT 75%, FRUIT 95%
 - GREAT AT DISSOLVING OTHER INGREDIENTS DUE TO HYDROGEN BONDING ABILITY
 - HYDROGEN BOND ALSO AFFECT BY TEMPERATURE
 - **LIQUID WATER ABSORBS A LOT OF HEAT AS IT VAPORIZES INTO STEAM**
 - HYDROGEN BONDING ALSO GIVES WATER AN UNUSUALLY HIGH “LATENT HEAT OF VAPORIZATION,” OR THE AMOUNT OF ENERGY THAT WATER ABSORBS WITHOUT A RISE IN TEMPERATURE AS IT CHANGES FROM A LIQUID TO A GAS.
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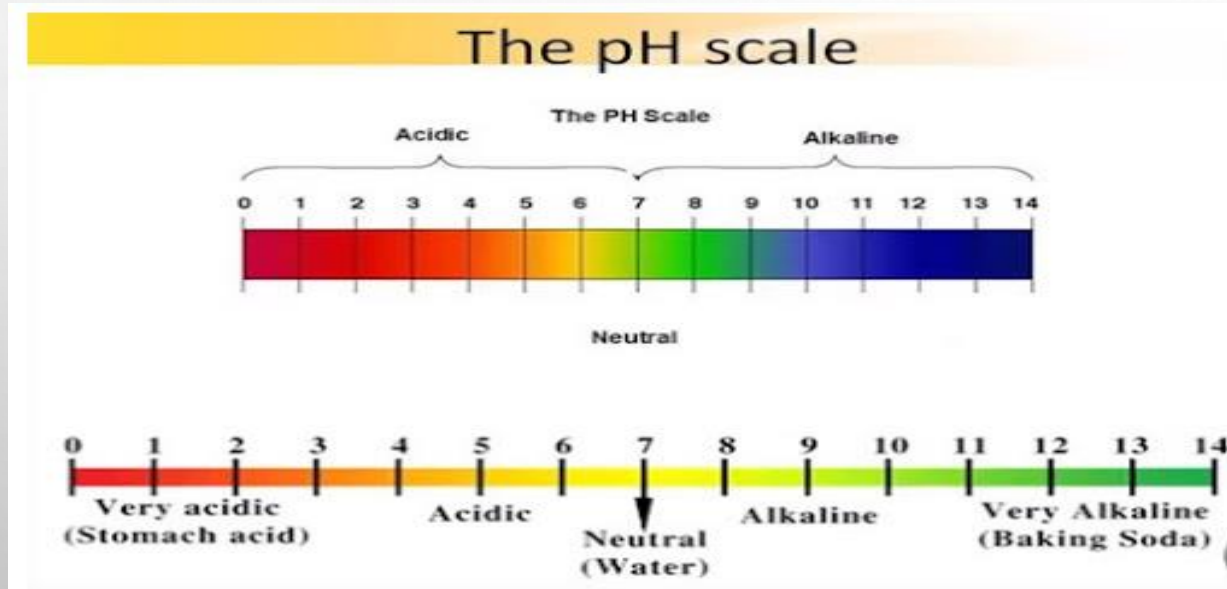


WATER H₂O

- **STEAM RELEASES A LOT OF HEAT WHEN IT CONDENSES INTO WATER**
 - WHEN WATER VAPOR HITS A COOL SURFACE AND CONDENSES INTO LIQUID WATER, IT GIVES UP THAT SAME HIGH HEAT OF VAPORIZATION. THIS IS WHY STEAM IS SUCH AN EFFECTIVE AND QUICK WAY OF COOKING FOODS COMPARED WITH PLAIN AIR— ALSO A GAS—AT THE SAME TEMPERATURE.
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WATER | H₂O

- PH METER / SCALE
 - ACID AND BASE (ASAM DAN BASA)



Liquid	pH
Human gastric juice	1.3–3.0
Lemon juice	2.1
Orange juice	3.0
Yogurt	4.5
Black coffee	5.0
Milk	6.9
Egg white	7.6–9.5
Baking soda in water	8.4
Household ammonia	11.9

PH METER CORRELATION

- **ACID AND HARD WATER MAINTAIN FIRMNESS**
 - VEGETABLES COOKS IN FRUIT JUICE OR TOMATO SC WILL REMAIN FIRM COMPARE TO OTHER NEUTRAL OR BASE LIQUID
- **SALT AND ALKALINITY SPEED SOFTENING**
 - ADDING BAKING SODA CAN REVERT THE PH METER OF WATER, THUS SOFTENING PROCESS CAN BE DONE FASTER
- **BACTERIA CAN GROW IN NEUTRAL PH METER**
 - PICKLING AS PRESERVATION METHOD

CARBOHYDRATES

- CARBOHYDRATES ARE PRODUCED BY ALL PLANTS AND ANIMALS FOR THE PURPOSE OF STORING CHEMICAL ENERGY, AND BY PLANTS TO MAKE A SUPPORTING SKELETON FOR ITS CELLS.
- DISSOLVE WELL IN WATER
- INCLUDE : SUGAR, STARCHY PLANTS, PECTIN
- PECTIN, CELLULOSE, AND OTHER CELL-WALL CARBOHYDRATES ARE THE PLANT'S STRUCTURAL MATERIALS.



SUGAR

- KNOWN AS ENERGY SOURCE OF LIVING ORGANISM AND “EASY TO BURN” CALORIES
 - BEFORE SUGAR : HONEY
 - EXTRACT FROM SUGAR CANE PLANT (KNOWN SINCE 1100) HIGH IN SUCROSE CONTENT FOUND IN NEW GUINE (SOUTHERN PACIFIC)
 - DIVIDE INTO GLUCOSE, FRUCTOSE, SUCROSE AND LACTOSE (SUGAR IN MILK)
 - KNOWN AS SIMPLEST CARBOHYDRATE
 - SUGARS COMBINE SEVERAL USEFUL QUALITIES IN ONE INGREDIENT: ENERGY, SWEETNESS, SUBSTANCE, MOISTURE BINDING, AND THE ABILITY TO CARAMELIZE
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SUGAR SUBS | HIDDEN SUGAR

- ABILITY OF CARBOHYDRATE TO RAISE GLUCOSE BLOOD LEVEL IN DIFFERENT FORM OF SUGAR
- THE MEASUREMENT KNOWN BY GLYCEMIC INDEX
- NEED TO CONTROL THE INTAKE IF YOU ARE LOWERING YOUR GLUCOSE BLOOD LEVEL

The Glycemic Index of Various Sugars and Foods

The "glycemic index" is a measure of how much a given food raises blood glucose levels. The glycemic index of glucose itself is set at 100.

Sugar	Glycemic Index	Sugar	Glycemic Index
Maltose	110	Table sugar	90
Glucose	100	Banana	60
Potatoes	95	Fruit preserves	55
White rice	95	Fructose	20
Honey	90		

SUGAR KIND

- **GLUCOSE**

- ALSO CALLED **DEXTROSE**
- A CHAIN OF TWO GLUCOSES IS CALLED **MALTOSE**
- GLUCOSE IS LESS SWEET, LESS SOLUBLE IN WATER, AND PRODUCES A THINNER SOLUTION.
- IT MELTS AND BEGINS TO CARAMELIZE AT AROUND 300°F/150°C.
- FOUND IN HONEY, PLANTS AND CORN SYRUP ALSO FRUIT MIXING WITH OTHER TYPE OF SUGAR
- GLUCOSE BURN INTO ENERGY IN HUMAN BODY

SUGAR KIND

- **FRUCTOSE**

- FOUND IN FRUITS AND HONEY, AND CERTAIN CORN SYRUPS ARE TREATED WITH ENZYMES TO CONVERT THEIR GLUCOSE INTO FRUCTOSE
- IS THE SWEETEST OF THE COMMON SUGARS, THE MOST SOLUBLE IN WATER (4 PARTS WILL DISSOLVE IN 1 PART ROOM-TEMPERATURE WATER), AND ABSORBS AND RETAINS WATER MOST EFFECTIVELY.
- OUR BODIES METABOLIZE FRUCTOSE MORE SLOWLY THAN GLUCOSE AND SUCROSE, SO IT CAUSES A SLOWER RISE IN BLOOD GLUCOSE LEVELS, A QUALITY THAT MAKES IT PREFERABLE TO OTHER SUGARS FOR DIABETICS.
- FRUCTOSE MELTS AND BEGINS TO CARAMELIZE AT A MUCH LOWER TEMPERATURE JUST ABOVE THE BOILING POINT OF WATER AT 220°F/105°C.

SUGAR KIND

- **SUCROSE**

- OTHERS NAME OF **TABLE SUGAR**
- CONTAIN GLUCOSE AND FRUCTOSE
- SUCROSE IS ALSO THE SECOND MOST SOLUBLE SUGAR—TWO PARTS CAN DISSOLVE IN ONE PART OF ROOM-TEMPERATURE WATER—AND IT PRODUCES THE GREATEST VISCOSITY, OR THICKNESS, IN A WATER SOLUTION.
- BEGINS TO MELT AROUND 320°F/160°C, AND CARAMELIZES AT AROUND 340°F/170°C.
- WHEN SUCROSE HEATED IN PRESENCE OF ACID IT WILL RESULT IN INVERT SUGAR/SYRUP
- INVERT SUGAR USES IN CANDY MAKING DUE TO LIMIT THE CRYSTALLIZATION OF SUCROSE

OTHERS SUGAR | SYRUP

- SYRUP IS KIND OF SUGAR WITH LIQUID FORM (NO CRYSTALLIZATION OR REFINED PROCESS)
- **HIGH FRUCTOSE CORN SYRUP (HFCS)**
 - MADE BY ADDING ENZYMES CALLED *ASPERGILLUS ORYZAE*
- **TREE SUGAR OR SYRUP**
 - MAPPLE
 - PALM
 - AGAVE

PROTEIN

- THE MOST SENSITIVE COMPONENT AMONG OTHER 3 FOOD MOLECULES
- HEAT, TEMPERATURE, SALT, ACID, AIR CAN CHANGE THEIR BEHAVIOR
- SMALLER UNIT OF PROTEIN CALLED AMINO ACID AND OTHERS CALLED PEPTIDES TAKE INTEGRAL PART IN COOKING
 - MAILLARD REACTION
 - MANY SINGLE AMINO ACIDS AND PEPTIDES HAVE TASTES OF THEIR OWN, AND IN FOODS WHERE PROTEINS HAVE BEEN PARTLY BROKEN DOWN— AGED CHEESES, CURED HAMS, SOY SAUCE—THESE TASTES CAN CONTRIBUTE TO THE OVERALL FLAVOR
 - SOME PEPTIDES HAVE A UNIQUE TASTE THAT IS DESIGNATED BY SUCH WORDS AS SAVORY, *BROTHY*, AND *UMAMI* (JAPANESE FOR “DELICIOUS”). THEY LEND AN ADDED DIMENSION OF FLAVOR TO FOODS THAT ARE RICH IN THEM, INCLUDING TOMATOES AND CERTAIN SEAWEEDS AS WELL AS SALT-CURED AND FERMENTED PRODUCTS. WHEN HEATED, SULFUR-CONTAINING AMINO ACIDS BREAK DOWN AND CONTRIBUTE EGGY, MEATY AROMA NOTES.

PROTEIN

- PROTEIN FOUND IN WHEAT, BARLEY AND RYE CALLED : GLUTEN, GLUTEN INTOLERRANT CANT PROCESS THIS PROTEIN IN THEIR STOMACH
- PROTEIN ABLE TO HOLD WATER INSIDE THEIR BODY COMPONENT, BUT IT CAN BE DRAWING OUT WHEN EXPOSED BY SALT AND HEAT
- **THERE'S A PARTICULAR GROUP OF PROTEINS THAT ARE IMPORTANT TO THE COOK NOT SO MUCH FOR THEIR DIRECT CONTRIBUTION TO FOOD TEXTURE AND CONSISTENCY, BUT FOR THE WAY THEY CHANGE THE OTHER COMPONENTS OF THE FOOD THEY'RE IN. THESE PROTEINS ARE THE *ENZYMES*.**
- **COOKING ACCELERATES ENZYME ACTION BEFORE STOPPING**

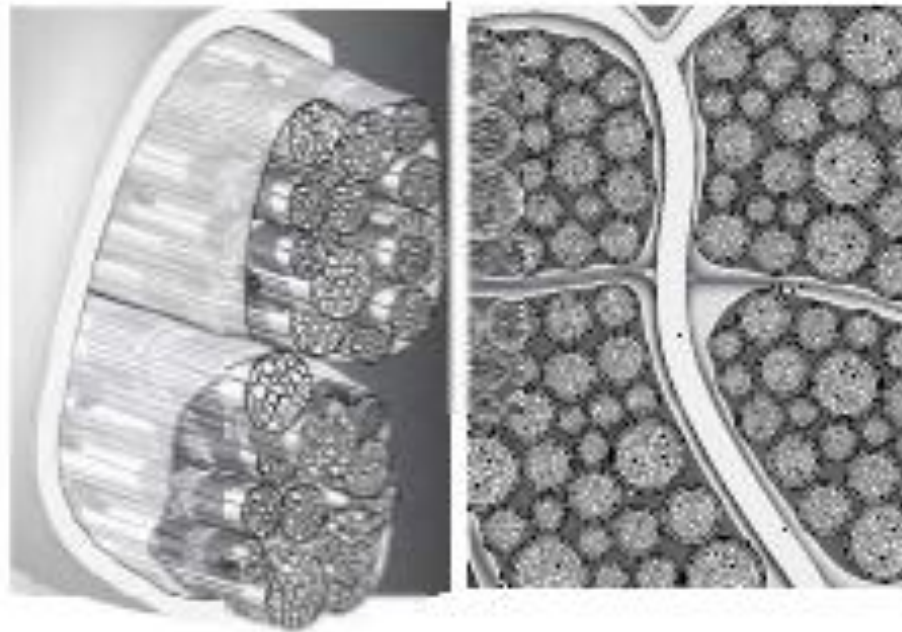
PROTEIN | MEAT

- LEAN MEAT IS MADE UP OF THREE BASIC MATERIALS: IT'S ABOUT 75% WATER, 20% PROTEIN, AND 3% FAT.
- THESE MATERIALS ARE WOVEN INTO THREE KINDS OF TISSUE.
 - THE MAIN TISSUE IS THE MASS OF MUSCLE CELLS, THE LONG FIBERS THAT CAUSE MOVEMENT WHEN THEY CONTRACT AND RELAX
 - SURROUNDING THE MUSCLE FIBERS IS THE CONNECTIVE TISSUE, A KIND OF LIVING GLUE THAT HARNESSSES THE FIBERS TOGETHER AND TO THE BONES THAT THEY MOVE
 - AND INTERSPERSED AMONG THE FIBERS AND CONNECTIVE TISSUE ARE GROUPS OF FAT CELLS, WHICH STORE FAT AS A SOURCE OF ENERGY FOR THE MUSCLE FIBERS

PROTEIN | MEAT

- THE MAJOR CONNECTIVE-TISSUE FILAMENT IS THE PROTEIN CALLED *COLLAGEN*, WHICH MAKES UP ABOUT A THIRD OF ALL THE PROTEIN IN THE ANIMAL BODY, AND IS CONCENTRATED IN SKIN, TENDONS AND BONES. THE NAME COMES FROM THE GREEK FOR “GLUE PRODUCING,” BECAUSE WHEN IT’S HEATED IN WATER, SOLID, TOUGH COLLAGEN PARTLY DISSOLVES INTO STICKY *GELATIN*
- GELATIN ONLY CAN BE RELEASE THROUGH CONTINUOUS HEATING.
- MEAT FLAVOR HAS TWO ASPECTS: WHAT MIGHT BE CALLED GENERIC MEATINESS, AND THE SPECIAL AROMAS THAT CHARACTERIZE MEATS FROM DIFFERENT ANIMALS. MEATINESS IS LARGELY PROVIDED BY THE MUSCLE FIBERS, CHARACTER AROMAS BY THE FAT TISSUE.

PROTEIN | MEAT



MEAT | AGING

- *DRY-AGED* DONE AT 34–38°F/1–3°C AND AT A RELATIVE HUMIDITY OF 70–80%. THE COOL TEMPERATURE LIMITS THE GROWTH OF MICROBES, WHILE THE MODERATE HUMIDITY CAUSES THE MEAT TO LOSE MOISTURE GRADUALLY, AND THUS BECOME DENSER AND MORE CONCENTRATED.
- LIKE CHEESE AND WINE, MEAT BENEFITS FROM A CERTAIN PERIOD OF AGING, OR SLOW CHEMICAL CHANGE, DURING WHICH IT GETS PROGRESSIVELY MORE FLAVORFUL
- THE AGING OF MEAT IS MAINLY THE WORK OF THE MUSCLE ENZYMES.
- ALL OF THESE BREAKDOWN PRODUCTS CONTRIBUTE TO THE INTENSELY MEATY, NUTTY FLAVOR OF AGED MEAT
- WET-AGED MEAT CAN DEVELOP SOME OF THE FLAVOR AND TENDERNESS OF DRY-AGED MEAT, BUT NOT THE SAME CONCENTRATION OF FLAVOR.
- WET AGED DONE IN SEALED PLASTIC VACUUM.



MEAT | COOKING

- AS THE MEAT'S TEMPERATURE RISES TO 140°F/60°C, MORE OF THE PROTEINS INSIDE ITS CELLS COAGULATE AND THE CELLS BECOME MORE SEGREGATED INTO A SOLID CORE OF COAGULATED PROTEIN AND A SURROUNDING TUBE OF LIQUID: SO THE MEAT GETS PROGRESSIVELY FIRMER AND MOISTER. THEN BETWEEN 140 AND 150°F/60–65°C, THE MEAT SUDDENLY RELEASES LOTS OF JUICE, SHRINKS NOTICEABLY, AND BECOMES CHEWIER
- IF THE COOKING CONTINUES, THE MEAT WILL GET PROGRESSIVELY DRYER, MORE COMPACTED, AND STIFF. THEN AROUND 160°F/70°C, CONNECTIVE-TISSUE COLLAGEN BEGINS TO DISSOLVE INTO GELATIN

MEAT DONENESS AND SAFETY

- IT TAKES TEMPERATURES OF 160°F/70°C OR HIGHER TO GUARANTEE THE RAPID DESTRUCTION OF THE BACTERIA THAT CAN CAUSE HUMAN DISEASE—TEMPERATURES AT WHICH MEAT IS WELL-DONE AND HAS LOST MUCH OF ITS MOISTURE. SO IS EATING JUICY, PINK-RED MEAT RISKY? NOT IF THE CUT IS AN INTACT PIECE OF HEALTHY MUSCLE TISSUE, A STEAK OR CHOP, AND ITS SURFACE HAS BEEN THOROUGHLY COOKED: BACTERIA ARE ON THE MEAT SURFACES, NOT INSIDE
- GROUND MEATS ARE RISKIER, BECAUSE THE CONTAMINATED MEAT SURFACE IS BROKEN INTO SMALL FRAGMENTS AND SPREAD THROUGHOUT THE MASS. THE INTERIOR OF A RAW HAMBURGER USUALLY DOES CONTAIN BACTERIA, AND IS SAFEST IF COOKED WELL DONE.



THANK YOU



