



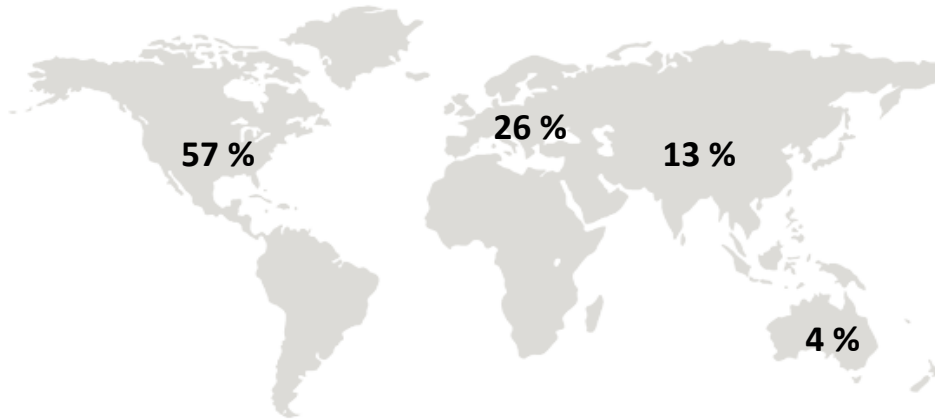
CONSIDERATION OF PRODUCT QUALITY IN THE LIFE CYCLE ASSESSMENT (LCA): CASE OF A MEAT PRODUCT TREATED BY HIGH PRESSURE

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HIGH PRESSURE PROCESSING (HPP)

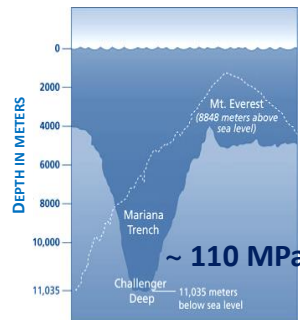
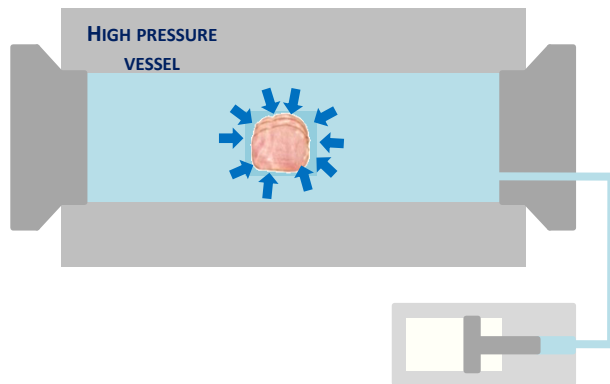


GLOBAL HPP FOOD PRODUCTION IN 2013:

+ 400 MILLIONS KG

MEAT PRODUCTS:

30% OF COMMERCIALIZED HIGH-PRESSURE TREATED PRODUCTS



WATER PRESSURE AT THE BOTTOM OF THE MARIANA TRENCH

MEAT PRODUCTS AFTER HPP:

EXTENDED SHELF LIFE AND IMPROVED FOOD SAFETY

HPP: 600 MPa, 3 MIN AT ROOM TEMPERATURE

HPP: ADDITIONAL STEP OF MEAT PROCESSING

IS HIGH PRESSURE TECHNOLOGY A SUSTAINABLE FOOD PROCESSING FOR MEAT PRODUCTS?

(1) LIFE CYCLE OF COOKED HAM:

-ADDITIONAL OPERATION

-EXTENDED SHELF LIFE



LCA

(2) FOOD QUALITY:

-INACTIVATION OF

LISTERIA MONOCYTOGENES



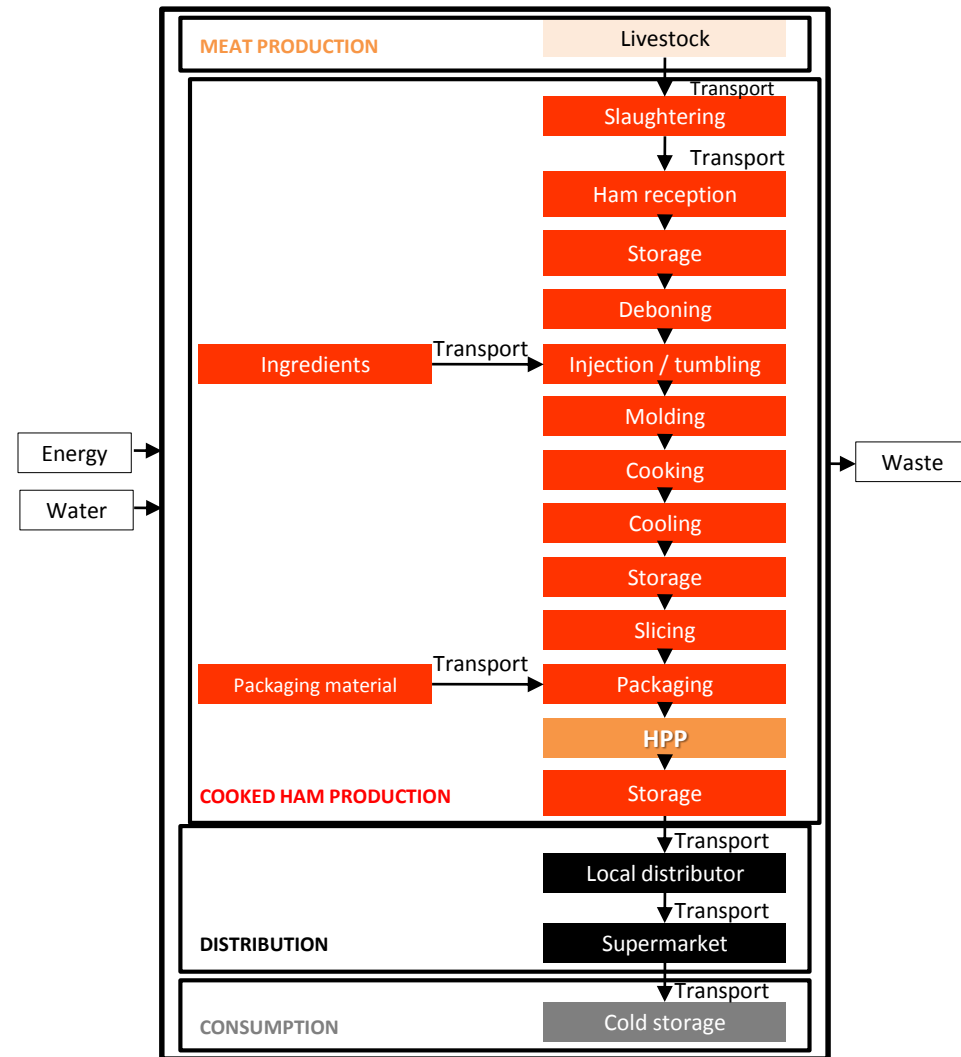
HUMAN HEALTH



OBJECTIVE: TO EVALUATE THE ENVIRONMENTAL IMPACT OF A COOKED HAM TREATED BY HIGH PRESSURE AND TO COMPARE IT WITH THE UNTREATED ONE, CONSIDERING THE FOOD QUALITY

(1) LCA

- A PROSPECTIVE STUDY IN FRANCE AT INDUSTRIAL SCALE
- ATTRIBUTIONAL LCA
- FUNCTIONAL UNIT: 1 KG OF COOKED HAM CONSUMED
- DATA FROM MEAT PROCESSOR IN FRANCE AND HIGH PRESSURE EQUIPMENT MANUFACTURER (2011)



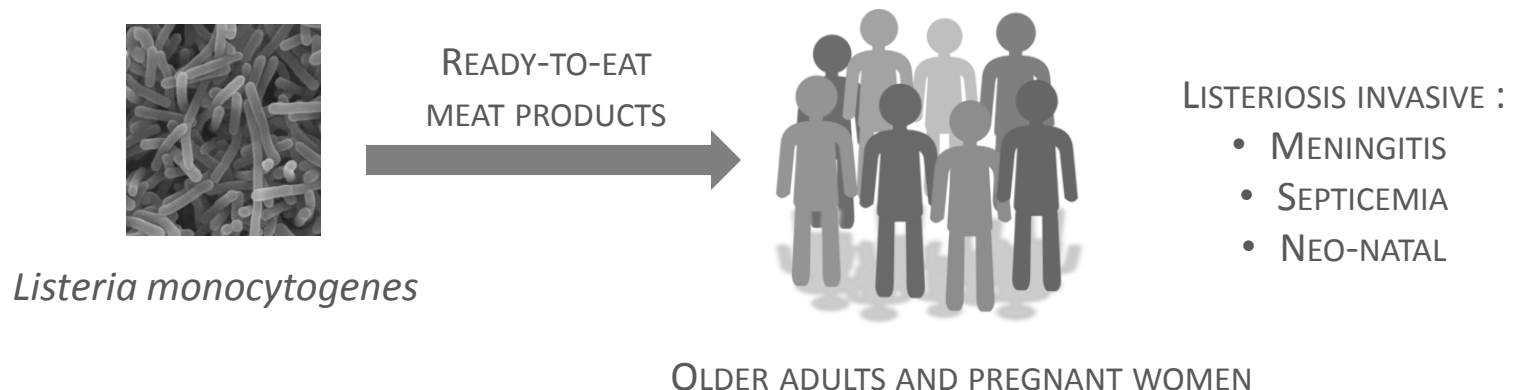
FLOW CHART OF THE SYSTEM FOR COOKED HAM

(1) LCA

- MASS ALLOCATION
- ELEMENTS NOT INCLUDED: CAPITAL GOODS, CLEANING PRODUCTS AND PACKAGING MATERIAL FOR TRANSPORTATION
- SIMAPRO 8.02 SOFTWARE
- IMPACT ASSESSMENT: CML-IA AND CUMULATIVE ENERGY DEMAND
- SENSITIVITY ANALYSIS: EXTENDED SHELF LIFE OF MEAT PRODUCT (WEEK OF STORAGE) AND CAPITAL GOODS (HIGH PRESSURE EQUIPMENT).

(2) CONSIDERING FOOD SAFETY BY A CHARACTERIZATION FACTOR: HEALTH EFFECTS DUE TO THE EXPOSURE TO *LISTERIA MONOCYTOGENES*

- DAMAGE TO HUMAN HEALTH : DISEASE BURDEN BY *LISTERIA MONOCYTOGENES*
- POTENTIAL BENEFIT OF USING HIGH-PRESSURE PROCESSING
- IMPACT ASSESSMENT : HUMAN HEALTH CATEGORY BY ECO – INDICATOR 99
- FOOD CONSUMPTION : INDICATOR OF HEALTH EFFECTS DUE TO THE EXPOSURE TO *LISTERIA MONOCYTOGENES* EXPRESSED AS DALY (DISABILITY – ADJUSTED LIFE YEARS)



(2) CONSIDERING FOOD SAFETY BY A CHARACTERIZATION FACTOR : HEALTH EFFECTS DUE TO THE EXPOSURE TO *L. MONOCYTOGENES*

- SEVERITY OF LISTERIOSIS “BRAFO TIERED APPROACH” (HOEKSTRA ET AL.,2012)

$$DALY_{a,s} = P_{\text{effect},a,s} \left(\underbrace{P_{\text{rec}} \cdot YLD_{\text{rec}} \cdot w}_{\text{RECUPERATION}} + \underbrace{P_{\text{die}} (YLD_{\text{die}} \cdot w + LE_{a,s} - CA - YLD_{\text{die}})}_{\text{DIE}} + \underbrace{(1 - P_{\text{die}} - P_{\text{rec}}) \cdot (LE_{a,s} - CA) \cdot w}_{\text{SEQUELAE}} \right)$$

$$P_{\text{effect}}(\text{meningitis or septicemia or neo-natal listeriosis}) = P_{\text{illness}} \cdot F_{(\text{meningitis or septicemia or neo-natal listeriosis})}$$

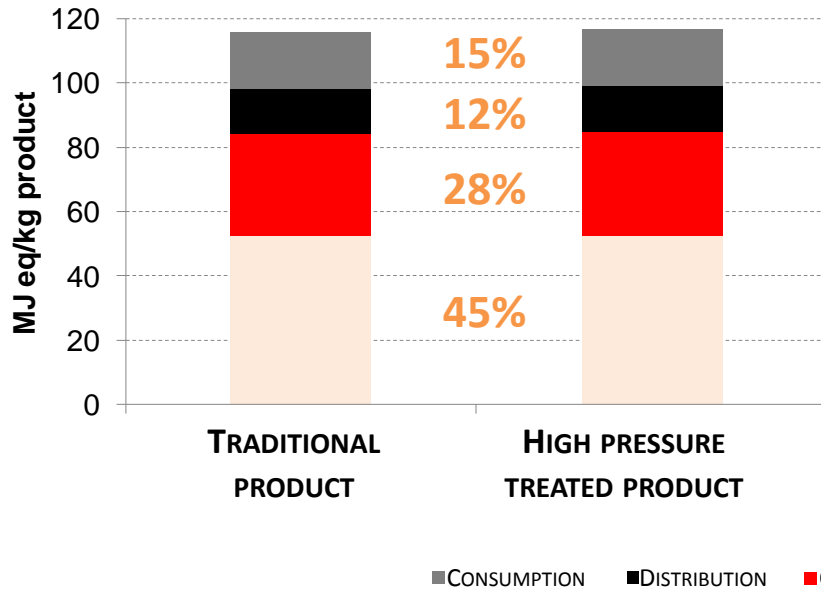
- EXPOSURE ASSESSMENT (WHO/FAO, 2004 ; EUROPEAN FOOD SAFETY AUTHORITY, 2013, MYERS ET AL. 2013)

$$P_{\text{illness}} = 1 - e^{-r \cdot \text{Dose}}$$

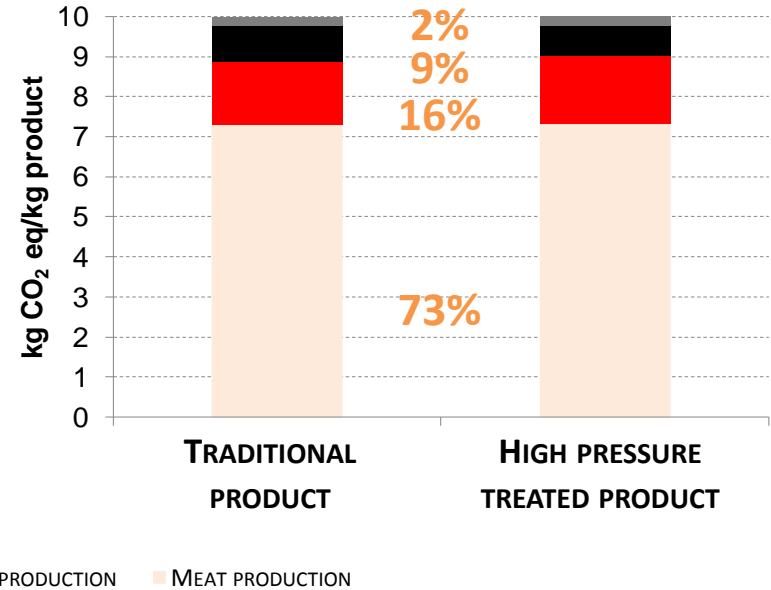
$$\text{Dose (cfu)} = \text{AVERAGE SERVING (g)} \cdot \text{CONTAMINATION LEVEL (cfu/g)}$$

- SENSITIVITY ANALYSIS: INCREASE OF AVERAGE SERVING, PREVALENCE AND INCREASE OF SENIOR POPULATION

NON-RENEWABLE ENERGY USE (NRE)



GLOBAL WARMING POTENTIAL

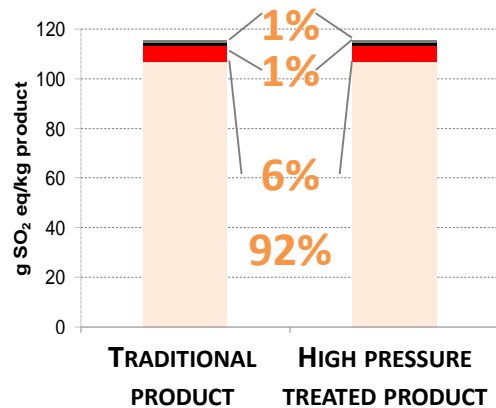


HIGH PRESSURE PROCESSING

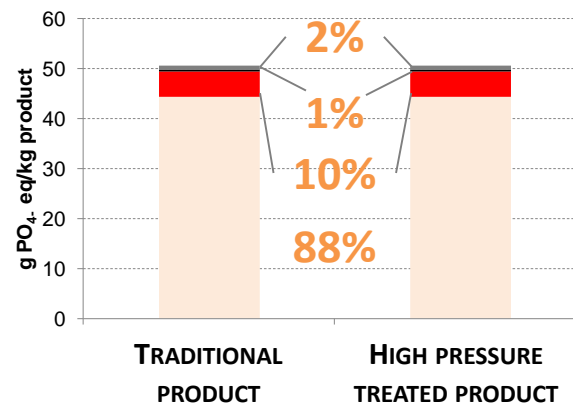
0.84 MJ OF NRE/KG OF CONSUMED COOKED HAM

9 G OF CO₂ EQ/KG OF CONSUMED COOKED HAM

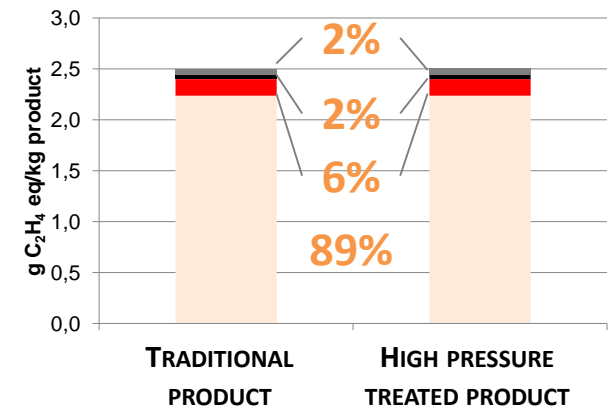
ACIDIFICATION



EUTROPHICATION



PHOTOCHEMICAL OXIDATION



■ CONSUMPTION ■ DISTRIBUTION ■ COOKED HAM PRODUCTION ■ MEAT PRODUCTION

SENSITIVITY RESULTS

- FUNCTIONAL UNIT (IMPROVED ECONOMIC VALUE OF 10%): DECREASE OF 8-9% THE ENVIRONMENTAL IMPACT OF HPP PRODUCT
- STORAGE TIME (PER WEEK OF STORAGE): THE USE OF NON-RENEWABLE ENERGY INCREASE OF 10% AND LESS THAN 1% FOR OTHER IMPACT CATEGORIES
- CAPITAL GOODS (HIGH PRESSURE EQUIPMENT): INCREASE LESS THAN 1%

CONSIDERING FOOD SAFETY : HEALTH EFFECTS DUE TO THE EXPOSURE TO *LISTERIA MONOCYTOGENES* (ECO-INDICATOR 99 FROM A HIERARCHIST PERSPECTIVE)

IMPACT CATEGORY	PER 1 KG OF COOKED HAM CONSUMED	WORST SCENARIO - TRADITIONAL PRODUCT			HPP PRODUCT
		0	7 DAYS	14 DAYS	14 DAYS
LISTERIOSIS	DALY	5.04E-11	1.73E-10	4.48E-08	0

HUMAN HEALTH : RESPIRATION-INORGANICS > CARCINOGENS > CLIMATE CHANGE > RADIATION > RESPIRATION-ORGANICS > OZONE LAYER

↑
 WORST CASE
 (MYERS ET AL. 2013)

↑
 (EFSA, 2013)

SENSITIVITY RESULTS:

- PREVALENCE LEVEL OF CONTAMINATION (1%): INCREASE OF 48.6%
- SERVING SIZE (1 G): INCREASE OF 6.3%
- POPULATION (INCREASE OF OLDER ADULT POPULATION 10%: 32% OF TOTAL POPULATION IN FRANCE) : INCREASE OF 36.6%

- ✓ THE CONTRIBUTION OF HIGH-PRESSURE PROCESSING, AS AN ADDITIONAL STEP OF MEAT PROCESSING, IS NEGLIGIBLE IN THE LIFE CYCLE OF COOKED HAM.
- ✓ HIGH PRESSURE PROCESSING COULD BE CONSIDERED AS A SUSTAINABLE FOOD PROCESSING FOR IMPROVING FOOD QUALITY OF COOKED HAM.
- ✓ MORE STUDIES ARE NEEDED TO EVALUATED THE ENVIRONMENTAL IMPACT OF DIFFERENT APPLICATIONS OF HIGH-PRESSURE PROCESSING (E.G., AS A SUBSTITUTE FOR PASTEURIZATION).
- ✓ FURTHER WORK IS REQUIRED TO INCLUDE THE QUALITY CHARACTERISTICS OF PRODUCTS IN THE LIFE CYCLE ASSESSMENT (E.G., LESS ADDITIVES) AND TO CONSIDER THEIR CONSEQUENCES (E.G., FOOD RECALL FOR LISTERIA CONTAMINATION).

Thank you for your attention