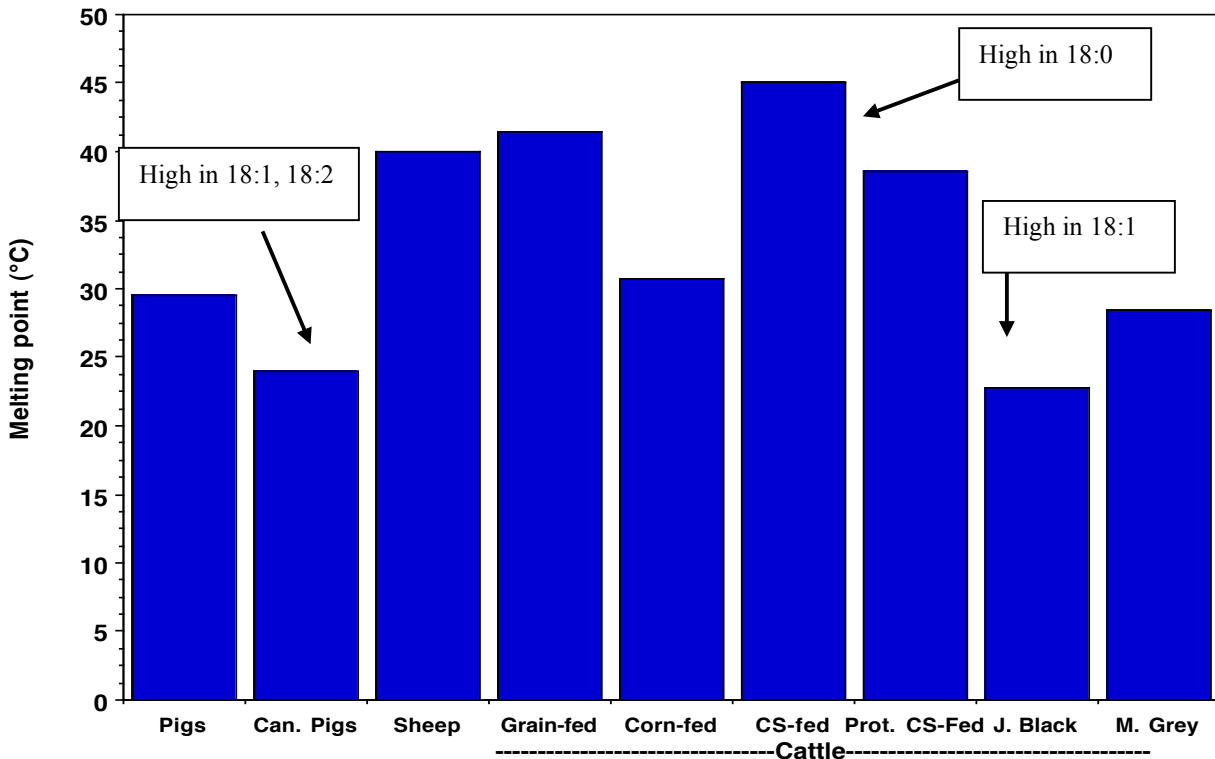


ANSC/NUTR 618
Lipids & Lipid Metabolism
Melting Points of Animal Fats

I. Melting points of animal lipids

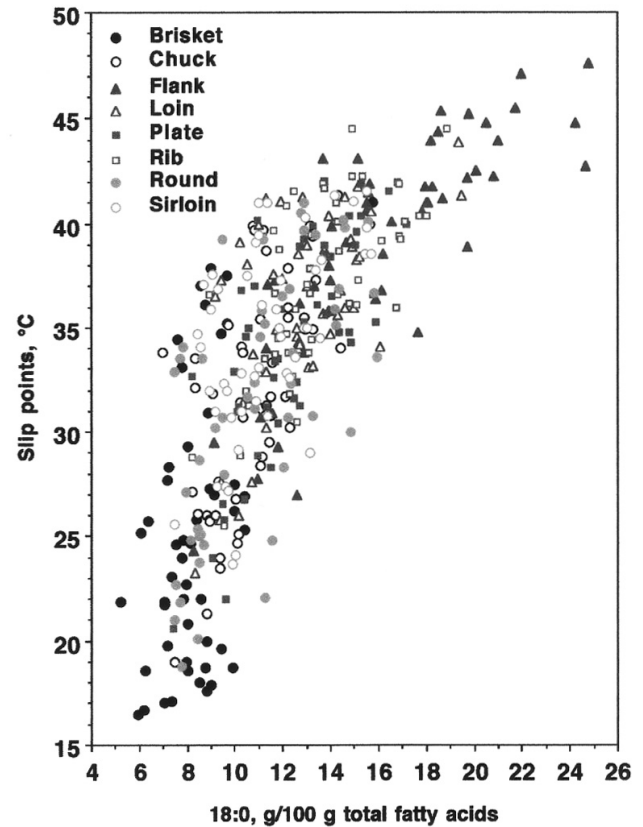
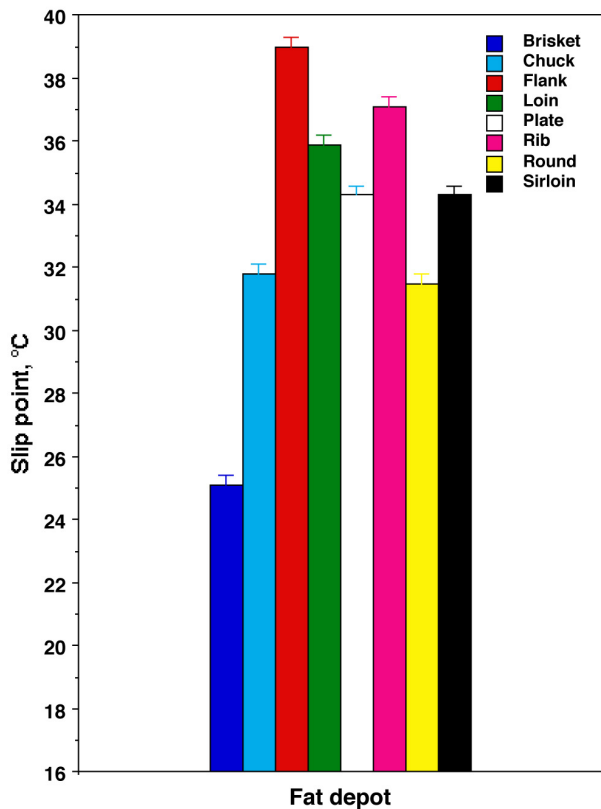
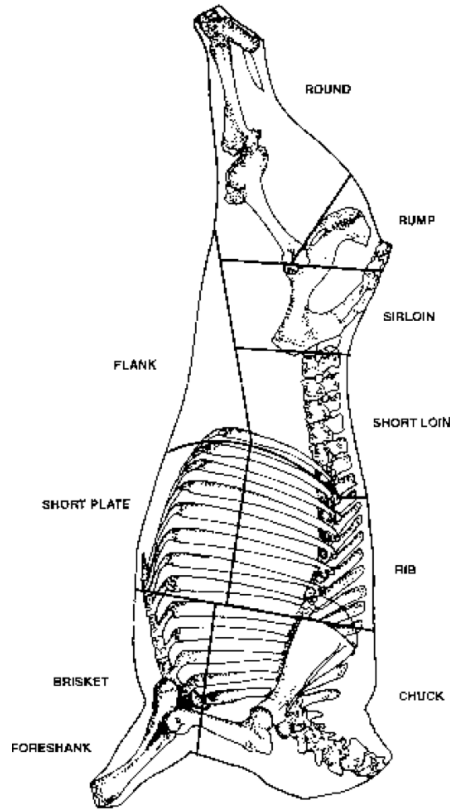
A. Differences among species/diets

1. For most animals, melting points of lipids are between 22 and 40°C.
2. Melting point is determined by fatty acid composition.
3. Fatty acid composition is determined by *diet, fat depot*, and *genetics*.
 - a. Lipids of tissues from monogastrics fed *unsaturated* fatty acids closely resemble fatty acid composition of the diet.
 - b. Composition of tissues of monogastrics fed *saturated* fatty acids is controlled by tissue desaturases, especially Δ^9 desaturase.
 - c. Composition of lipids of tissues from ruminants is determined by diet, ruminal modification of fatty acids, and activity of tissue desaturases (which differs across different fat depots).



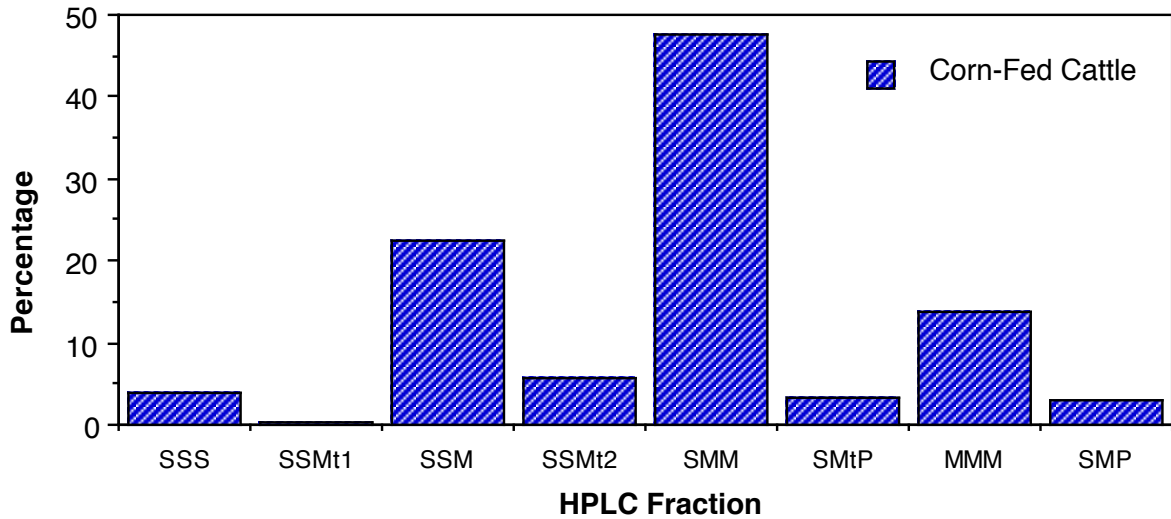
B. Differences across fat depots

1. Lipid from adipose tissue overlying the brisket has an usually low melting point.
2. The flank has the highest melting point.
 - a. The brisket is very low in stearic acid and high in oleic acid.
 - b. The flank and other adipose tissue depots are high in stearic acid and low in oleic acid.
3. The concentration of stearic acid is the primary determinant of melting point for animal lipids.
 - a. As stearic acid increases, oleic acid decreases.
 - b. The concentration of stearic acid ultimately is determined by the activity of stearyl-CoA desaturase.

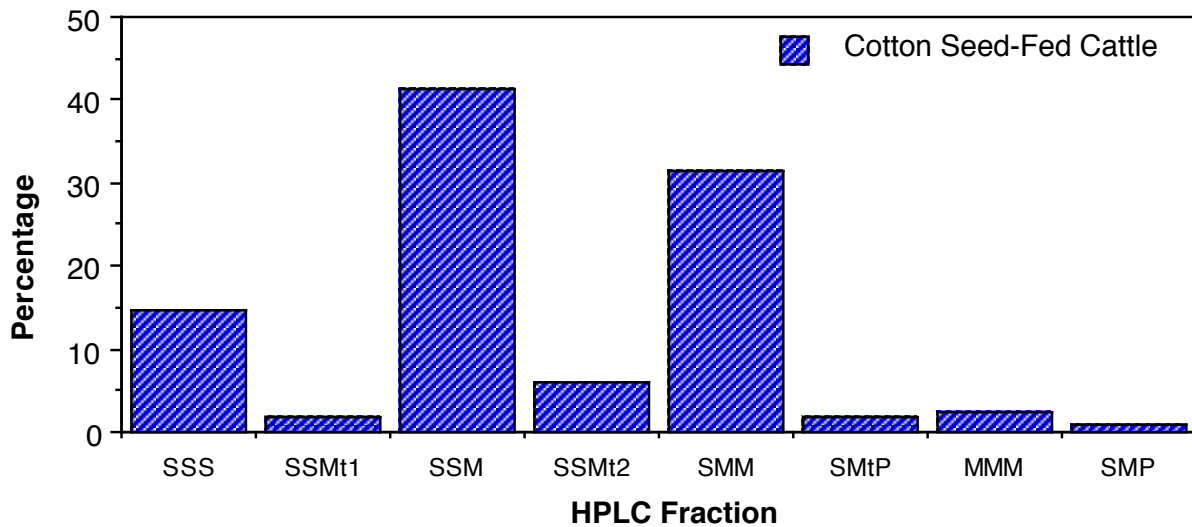


C. Biochemical basis for melting point of lipids

1. There are many classes of triacylglycerols (TAG) within each fat depot.
2. The TAG are heterogeneous.
 - a. Each class of TAG contains a mixture of fatty acids.
 - b. Each mixture of fatty acids will proportionately influence lipid melting points.



	SSS	SSMt1	SSM	SSMt2	SMM	SMtP	MMM	SMP
16:0	50.1		37.8	20.7	22.4	14.2	0.4	20.3
16:1	0.3		3.6	2.0	6.4	4.1	10.3	2.4
18:0	32.1		17.9	12.9	6.0	9.8	0.2	10.3
18:1t11	0		1.4	21.6	0.13	13.7	0.5	0
18:1c9	0.1		29.1	38.4	57.4	42.0	77.1	33.5
18:2	0		0.1	0	0.1	7.9	0.8	27.1

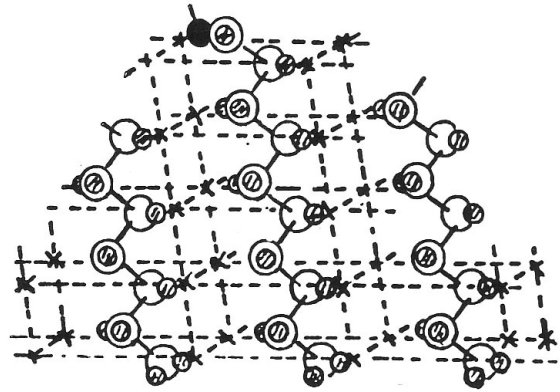


	SSS	SSMt1	SSM	SSMt2	SMM	SMtP	MMM	SMP
16:0	30.6		23.2	18.1	15.9	11.3	2.8	22.7
16:1	0.3		1.2	.5	2.3	0.7	2.3	1.1
18:0	61.5		34.5	18.3	11.6	33.1	13.9	9.7
18:1t11	0		0.6	16.2	0.1	3.7	0.8	0
18:1c9	0		35.4	43.4	67.1	40.3	76.0	33.8
18:2	0		0	0.1	0.1	8.6	1.8	30.2

D. Biochemical basis for melting point of lipids

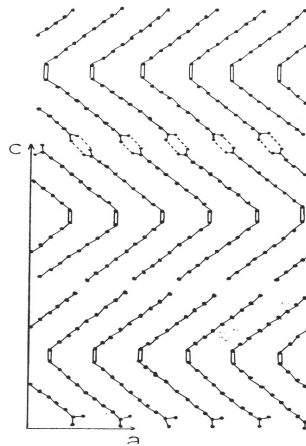
1. Fatty acid subcells

- Fatty acids form crystals with ordered structure.
- The crystals typically display subcells between portions of the molecules (usually two carbons in length).
- Subcells are established by hydrophobic bonds across methylene carbons.



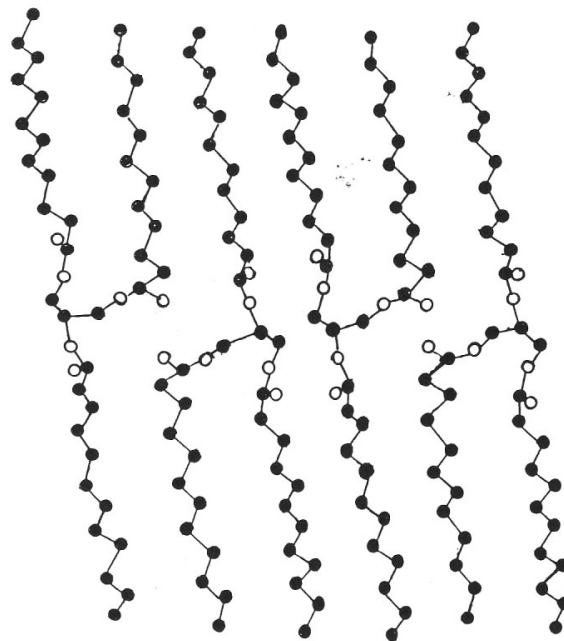
2. Fatty acid crystals

- Crystals of oleic acid (**at right**) have a highly ordered structure.
- The *cis* double bonds are tilted in opposite directions to the plane of the molecules.
- This configuration provides maximum van der Waals forces.



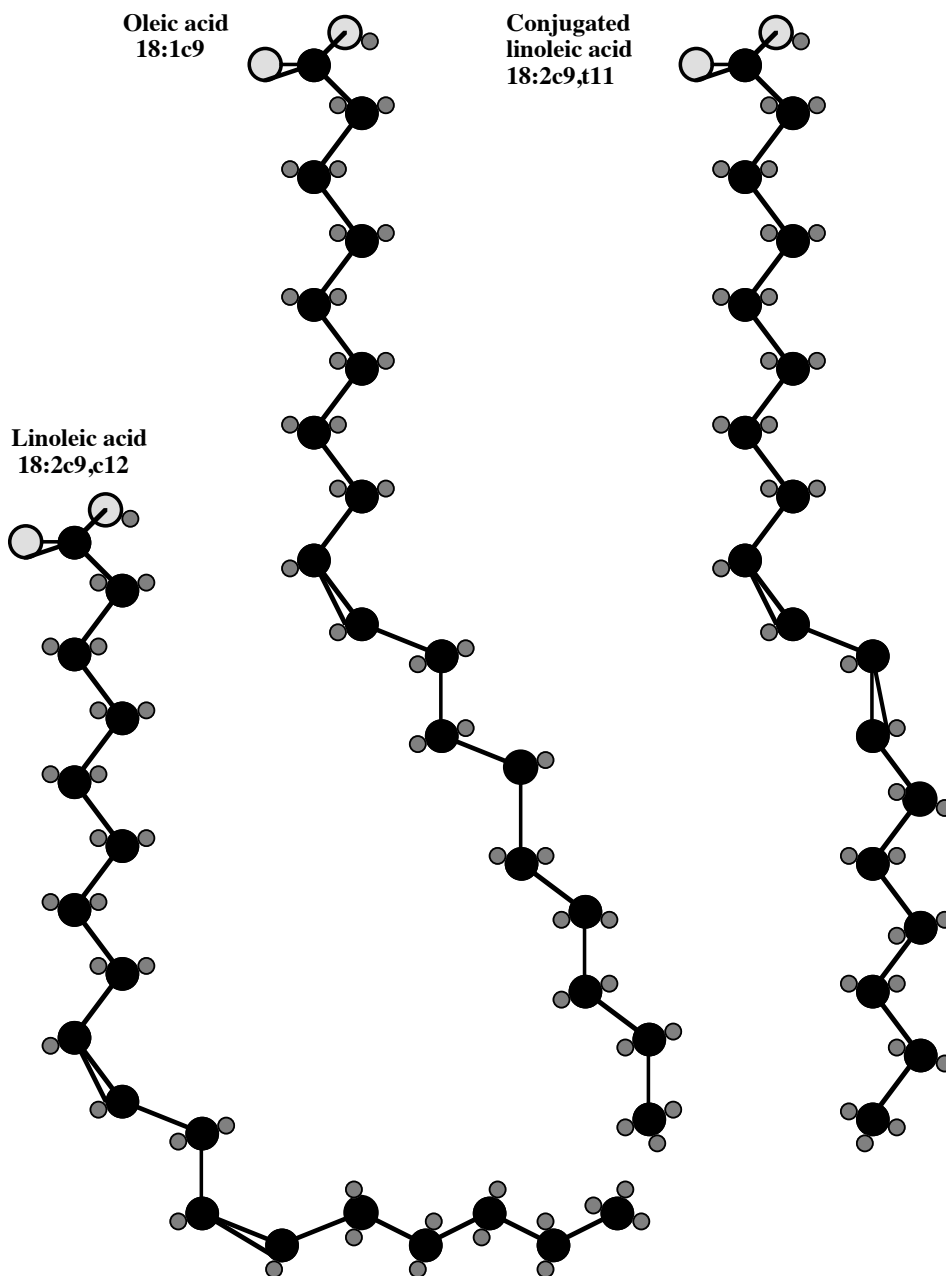
3. Triacylglycerol crystals

- Crystals of TAG (such as trilaurin, **right**) are highly ordered.
- Hydrophobic side chains associate with each other.
- More polar glycerol backbones also associate with one another.
- Increasing the number of carbons of a saturated fatty acid increases the melting point.

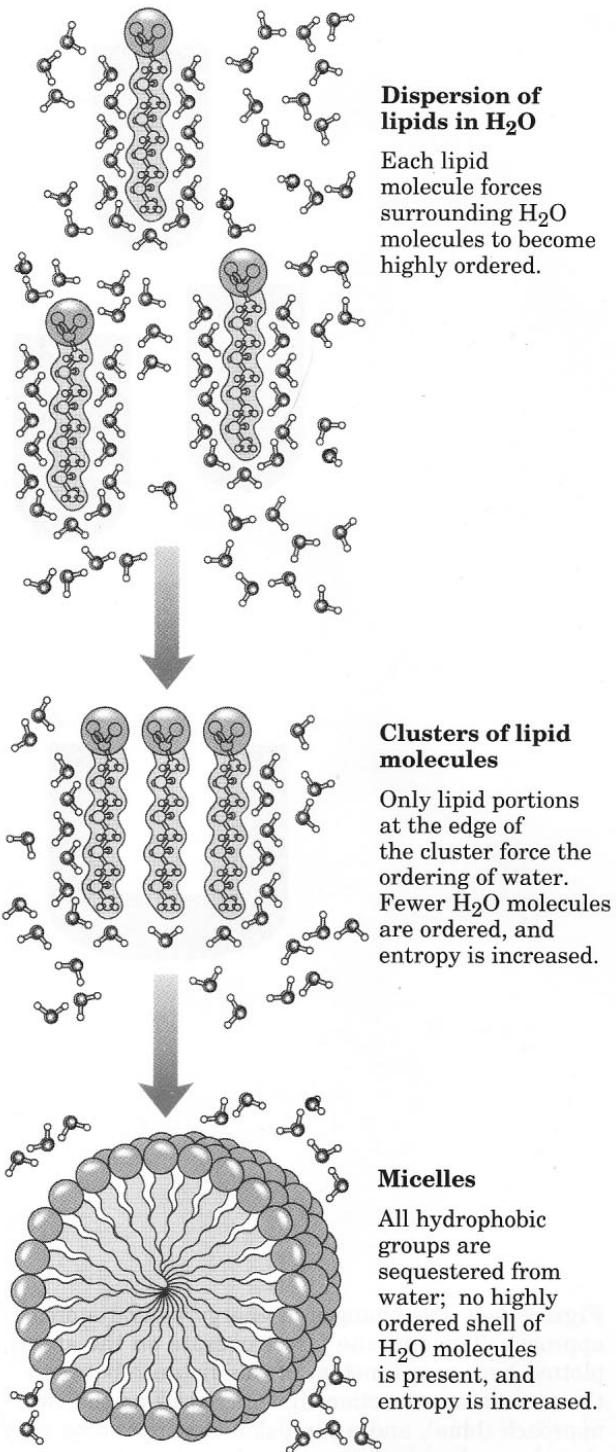


4. Double bonds and fatty acid crystals

- a. *cis*-Double bonds introduce bends in the fatty acids.
 - 1) Subcells cannot form as readily.
 - 2) Hydrophobic forces among subcells are weaker.
- b. *trans*-Double bonds do not cause a bend in the fatty acid.
 - 1) Subcells form readily.
 - 2) Melting points are similar to saturated or monounsaturated fatty acids.



II. Hydrophobic interactions



(b)

A. Description

1. Hydrophobic interactions are *not* chemical bonds.
2. Represent the most stable state when nonpolar molecules are surrounded by water molecules.

B. Characteristics

1. Hydrophobic portions of nonpolar or amphipathic (polar plus nonpolar) molecules become surrounded by water molecules.
2. The layer of water molecules causes a decrease in entropy.
2. To reach a more stable state (higher entropy), the nonpolar molecules aggregate.
3. In the case of amphipathic molecules, micelles can form.