WET matter versus DRY matter basis – What's the difference?

Ewildagain.org provides considerable quantitative data about various milk replacer products and other substitute milk formula ingredients – both in dry form and wet form.

The DRY form is a powder, prior to mixing with water.

The WET form is either 1) a product purchased already in a liquid form, or 2) a dry powder after mixing it with water.

The component percentage values for solids, moisture and ME kcals are significantly different, depending on whether the product is in the dry or wet form.

Questions and misconceptions arise because of this difference between wet and dry forms, and at times, due to ambiguous disclosures on the product labeling. Examples include:

1.) The lab analysis for powdered Esbilac® displayed on this website (and contained in WildAgain's Nutrition Calculator) indicates kcals/gram generally ranging from 5.3 to 5.5. At the same time, the package label represents an energy content of 13.5 kcals/tbs (when mixed 1:2 water). Are these numbers representing the same value? How can they be converted to compare?

2.) The can of liquid Esbilac® indicates it contains >4.5% protein, while the can of powdered Esbilac® is greatly different at >33% protein. Does the liquid contain too little protein or does the powder contain too much?

Consider columns B and C in the table below. Column B shows the values for liquid Esbilac® with solids at around 15%. That means that most of the can is water. Column C shows the values for powdered Esbilac® with solids around 95%. Most of the package is dry powder, with very little moisture or water content. The more total solids a product contains, whether in a wet form or a dry form, the more nutrients such as protein, fat, carbohydrates, minerals, etc. it contains, instead of water.

Understanding the dry matter values is beneficial in two ways. First, it provides a basis when comparing values of other products, making sure they are comparable on a dry to dry basis, such as shown on the page displaying values from the

proximate analysis (proteins, fats, etc.). Second, it provides the user with a starting point to estimate what the wet values will be when mixed with water.

[Note: In deference to technical accuracy, the term 'dry matter basis' refers to a substance where all of the moisture (water) has been removed, which makes analysis of wet and dry foods most easily comparable on a 100% dry basis. To make this discussion more straightforward, and to avoid considerable math and conversions, the term 'dry' used herein means "powder as purchased and prior to mixing with water," recognizing that the milk replacer products contain 4-6% moisture (water).]

The table below and the accompanying explanations provide a more thorough overview of the difference between wet and dry matter values. It uses the Eastern gray squirrel as an example, comparing the values of the mother's milk to a formula based on using powdered Esbilac®. Similar comparisons may be easily developed for other species by using the Nutrition Calculator.

	A	B	C	D	E	F	G	H
	Ea. gray squirrel mother's milk	Esbilac® sold as liquid in a can	Esbilac® powder					
	Wet Matter	Wet Matter	Dry Matter (powder in the can/package)		Wet Matter (formula ready to feed)			
Wet matter / *Dry matter*			Powdered Esbilac® label (Guaranteed Analysis)	Independent lab test results	1 part Esbilac®:2 parts water (as per label instructions and based on label values)		1 part Esbilac®:2 parts water Plus .333 part heavy cream based on label values)	
	From mother, as-fed	Ready to use, as-fed	(Prior to mixing with water)		As-mixed, as-fed	% of mother's milk	As-mixed, as-fed	% of mother's milk
Solids %	26.5	> 15	> 95	95.6	16.8	63%	19.9	75%
Protein %	9	> 4.5	> 33	35.5	6.2	68%	5.7	63%
Fats %	12.1	> 6.0	> 40	37.2	6.5	53%	10.2	83%
Kcals/gr	1.57	0.9	0.9	5.4	0.95	59%	1.26	79%

(per label; 1:2 mix)

Column A. This column shows the values for the Eastern gray squirrel mother's milk based on an average of the proximate analysis values reported in the studies conducted by Shaul (1962) and Nixon and Harper (1972). Values shown are for the percent of total solids, protein and fat as contained in the milk. The kcals (calorie or energy) value for 1gram (or 1cc) of milk is also shown, using the standard Atwater system calculation. These values are generally used a starting reference point when designing any formula recipe based on using one or more of the powdered milk replacer products. This column is on an as-fed or wet matter basis.

Column B. This column shows the values for Esbilac® sold as liquid in a can. Most rehabilitators do not purchase this form of milk replacer, as they are more expensive, require more storage space than powdered products, and once opened, must be used quickly. This column is on a ready-to-use, as-fed or wet matter basis.

Column C. This column shows the nutritional values for Esbilac® powder. This is the form of milk replacers preferred by most rehabilitators due to lower cost and easier storage. These values are listed on the labeling for the product and indicate either minimums or maximums, commonly referred to as the Guaranteed Analysis. Note: The value for kcals is not provided on a dry basis on the label but is only reported on a wet basis for a formula reconstituted at 1 part powder mixed with 2 parts water. The label introduces confusion in two ways. First, in describing the product, it displays different numbers on a different basis. It states dry form for nutritional components, and wet form for kcals. Second, while a value for ME (kcals) is provided, it lacks an accompanying descriptor indicating the calculation convention used - whether standard Atwater, or the lesser value modified Atwater adopted by the Association of American Feed Control Officials (AAFCO). Unfortunately, this column mixes apples and oranges as to a common matter basis.

Column D. The values in this column are the results of independent laboratory testing for 13 lots of Esbilac® produced in 2019. A proximate analysis was performed, as well as a mineral analysis. These are all dry matter values, and are much more precise and reliable than the Guaranteed Analysis values shown in column C. These values are accurate to within the +/- 5-7% which is the generally accepted analytical measurement error. This column is on a dry matter basis (again defined as the powder in the package).

Columns E and F. The values in column E are for a wet formula that was prepared using one part of powder and two parts water, as directed on the Esbilac® label. The percentage values for solids, protein and fat are much lower than the values in Column C, since the full-strength powder has been diluted by mixing it with water. Column F shows that this formula falls below the values for the mother's milk (Column A) by 50-60%.

Columns G and H. The values in column G are for a wet formula that was prepared using one part powder, 2 parts water, and 1/3 part heavy whipping cream. Again, the percentage values for solids, protein and fat are much lower than the values in Column C, since the powder was diluted by mixing with the water and cream. But as shown in Column F, this formula recipe more closely matches the values for the mother's milk (Column A), within about 60-80%. To prepare a formula that approaches 100% of mother's milk would require a level of solid matter that is not well tolerated by very young squirrels. Mother's milk admittedly contains more solids, as it is precisely tailored to be digestible by the squirrel's developing digestive system – certainly more so than a commercial milk replacer powder.

Conclusion

The Nutrition Calculator mentioned above takes care of all of the required math and conversions from dry to wet matter basis, even when combining dry ingredients (milk replacers) with wet ingredients (water, cream etc.). Allow it to do that work for you! Should you glance at a package label that seems confusing because it

seems to imply that wet and dry matters are somehow interchangeable, just know they are NOT. It is confusing. Only after you understand the differences in how they are presented and calculated, can you then realize they must be normalized to some comparable basis, generally a dry matter basis.

A take-home message of this discussion can be illustrated by the following thought and example. In the past, many people have refused to consider using liquid Esbilac® in the can because it is so dissimilar to the powdered version in terms of nutrient content, with some referring to it as 'Esbilac® Light.' Given the discussion of wet vs dry above, let's see if this is actually a true characterization…

	B	E
	Esbilac® sold as liquid in a can	Esbilac®
	Wet Matter	Wet
Wet matter / *Dry matter*		1 part Esbilac®: (as per label ins based on lab
	Ready to use, as-fed	As-mixed, as-fed
Solids %	> 15	16.8
Protein %	> 4.5	6.2
Fats %	> 6.0	6.5
Kcals/gr	0.9	0.95

The table to the right excerpts from the larger table in the discussion above, focusing just on columns B and E. Since these columns are both on a wet matter basis (B showing liquid can values and E showing the powder reconstituted 1 part powder to 2 parts water), they can now be compared on an "apples to apples" basis. As shown, the nutrient values and kcals are so very similar, such that the label of a 'Light' product is most likely unwarranted.