The Ancient Roots of Milk Consumption and its Genetic Dependence

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Abstract - Milk from domestic cows has been a valuable food source for over 8,000 years. However, humans can take full advantage of this food source only if adults have the ability to tolerate milk as a food. The ability to digest milk as adults is genetically controlled with most of the world's adult population not being able to produce lactase, the enzyme that digests the milk sugar lactose. In this paper, modern day milk consumption by country is shown to be highly correlated with the frequency in the population of the genetic trait for lactose tolerance. This suggests that genetics rather than culture is the governing factor that determines per capita milk consumption.

Discussion

The Funnel Beaker Culture of Northern Europe has been identified as one of the first populations to raise cattle and consume milk products more than 5,000 years ago [1,2]. This ancient population gets its name from the unusual shape of their characteristic vessels, which often have flared rims[3]. See:

http://www.earlyfarmers.net/index.php?main=m_culture&nr=2&l=en

The area associated with the Funnel Beaker culture is extensive and ranges from Southern Norway to the Czech/Austrian border and from the Netherlands to the Ukraine. It is remarkable that when the frequency of milk tolerance in modern populations is plotted by geography the area of the highest milk tolerance substantially coincides with the region of the Funnel Beaker Culture [4]. As distance from this ancient center of milk consumption increases, so does the frequency of milk intolerance. The genes for milk tolerance seems to have spread outward from the source in North Central Europe in much the same way as waves on the surface of a pond when a small stone is thrown in the water. This is certainly consistent with the view that drinking milk offered some survival advantage to those who possessed the genes for lactose tolerance, otherwise it would not have spread.

The recent identification of the genetic source of lactose tolerance leaves no doubt that the ability to digest milk is genetically controlled in most cases[3].

As mentioned previously, the geographic extent of the Funnel Beaker Culture is defined by the presence of its unique pottery with the flared rim [3]. Another important characteristic of these ancient peoples is that they were among the first to use milk and milk products. Is there some relationship between the unusual shape of their funnel shaped vessels and the fact that they kept dairy cattle? I think there is such a connection. It seems very likely that the funnel shaped pots were designed specifically to collect milk. Consider that the cow does not always stand perfectly still when being milked. A collection vessel with a funnel shaped top would offer some advantages and would save some milk that would otherwise be spilled due to unexpected movement as the cow was being milked. Even today, some pails for hand milking have slightly sloping rather than vertical sides.

Figure 1 (see attached image file for Figure 1) shows the correlation between annual milk consumption per person, by country, versus the frequency of milk tolerance in that country. The straight line shown is the best fit to the data. The annual milk consumption varies enormously from a low of 3.6 kg per person per year in China to a high of above 140 Kg per person per year in several of the countries in North Central Europe associated with the ancient Funnel Beaker Culture. Both Ireland and Finland have very high milk consumption with Ireland being the highest according to the statistics of the United States Department of Agriculture. However some sources cite Finland as being the country of highest milk consumption. The percentage of the population in China that is lactose tolerant is 7 percent while the percentage in Ireland is 98 percent. Other countries for which data are available fall within that range. Although Ireland is not in the region of the Funnel Beaker Culture, it is known that even in historic times Vikings were a major influence in Ireland and in England and there may have been migrations of people from the Funnel Beaker region even before recorded history. The tolerance frequencies plotted in Figure 1 are from various sources (4, 7, 8) while the milk consumption data are from The Department of Agriculture of the United States (9) for the year 1997. Statistics on milk consumption by country vary considerably from various sources and there are slight changes by year, however, the strong correlation between consumption and milk tolerance persists regardless of which date set is used.

It is interesting that Iceland has very high milk consumption although it is not plotted in the figure because the frequency of lactose tolerance for Iceland was not available. In a recent year, the annual consumption of milk in Iceland was approximately 158 liters, which is approximately the same number in kilograms. This makes Iceland the third highest country in milk consumption below Sweden and Ireland. It is very likely that in view of the high milk consumption in Iceland, the frequency of milk tolerance must be above 90 percent. It is interesting that the struggling Viking colony in Greenland made valiant efforts to maintain their cattle herds in spite of a climate that was not very well suited to cattle. They had to feed their cattle for a large fraction of the year and keep them indoors for many months. Most likely the Greenland colony also had a high percentage of lactose tolerance and milk was probably an important part of their diet.

It might seem that the results shown in Figure 1 are only what would be expected. That is, it is perhaps not surprising that there is high milk consumption in those countries where there is also a high percentage of the population that is lactose tolerant. But that result would not necessarily be predicted. In fact the correlation is only approximate and not perfect. For instance Poland has high milk consumption while having a tolerance frequency of only 63 percent. This is may be due to imperfections in the data. For instance some countries are known to have rapidly changing frequencies of milk tolerance as distance increases from the ancient center of the Funnel Beaker Culture. In other words, the samples collected with respect to lactose tolerance may not be entirely representative of the whole population. If we assume that the milk consumption data for Poland is correct, then the lactose tolerance of 63 percent may be mistakenly low and not representative of the entire population. This could easily happen if the individuals sampled were from one area of the country rather than spread somewhat randomly over the entire country. That portion of Poland in or near the funnel beaker region has a higher frequency of lactose tolerance than more distant regions.

There is another reason why the high correlation between milk tolerance and milk consumption might not have been predictable. Even in a region where there is a high frequency of milk tolerance, local traditions might encourage the drinking of other beverages at the expense of milk. Why couldn't a country with 98 percent milk tolerance drink only a little milk? For whatever reasons, that does not seem to happen. Those regions where populations are able to digest milk drink it in very substantial amounts.

The states of Wisconsin and Minnesota are well known for their important dairy industry and the slogan of Wisconsin is "America's Dairyland". It is probably not a coincidence that these two states have received large numbers of immigrants from the region of the ancient Funnel Beaker Culture, i.e. Norway, Sweden, The Netherlands. The ability to drink milk and the ancient traditions of dairying must have played a part in establishing the industry in Wisconsin and Minnesota. Even some of the well known brand names in dairy products (in Nevada) such as Anderson and Knudsen are suggestive of an origin from the region of the Funnel Beaker Culture. The most numerous breed of dairy cattle, the Holstein, originated in the Netherlands, i.e, in the region of the Funnel Beaker people. The exact origin and development of the Holstein breed seems to predate historical records but most accounts suggest that the breed dates to at least 2,000 years ago, making it one of the oldest distinct breeds of cattle. Unless the geographic origin is just a coincidence, it seems likely that the ancestors of the Holstein breed may have been the cattle associated with the Funnel Beaker people.

Conclusions

Current milk consumption seems to be strongly influenced by the inherited ability to digest lactose. There is a remarkable positive correlation between the milk consumption in a country and the frequency of lactose tolerance in the population. The distinctive pottery of the Funnel Beaker people consists of a flared rim from which the culture derives its name. It seems likely that this characteristic shape had a very practical

purpose which was to reduce the amount of milk lost during the milking process. Apparently this explanation for the flared shape of the funnel beaker vessels has not previously been suggested.

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Milk Consumption By Country Vs. Milk Tolerance - Figure 1

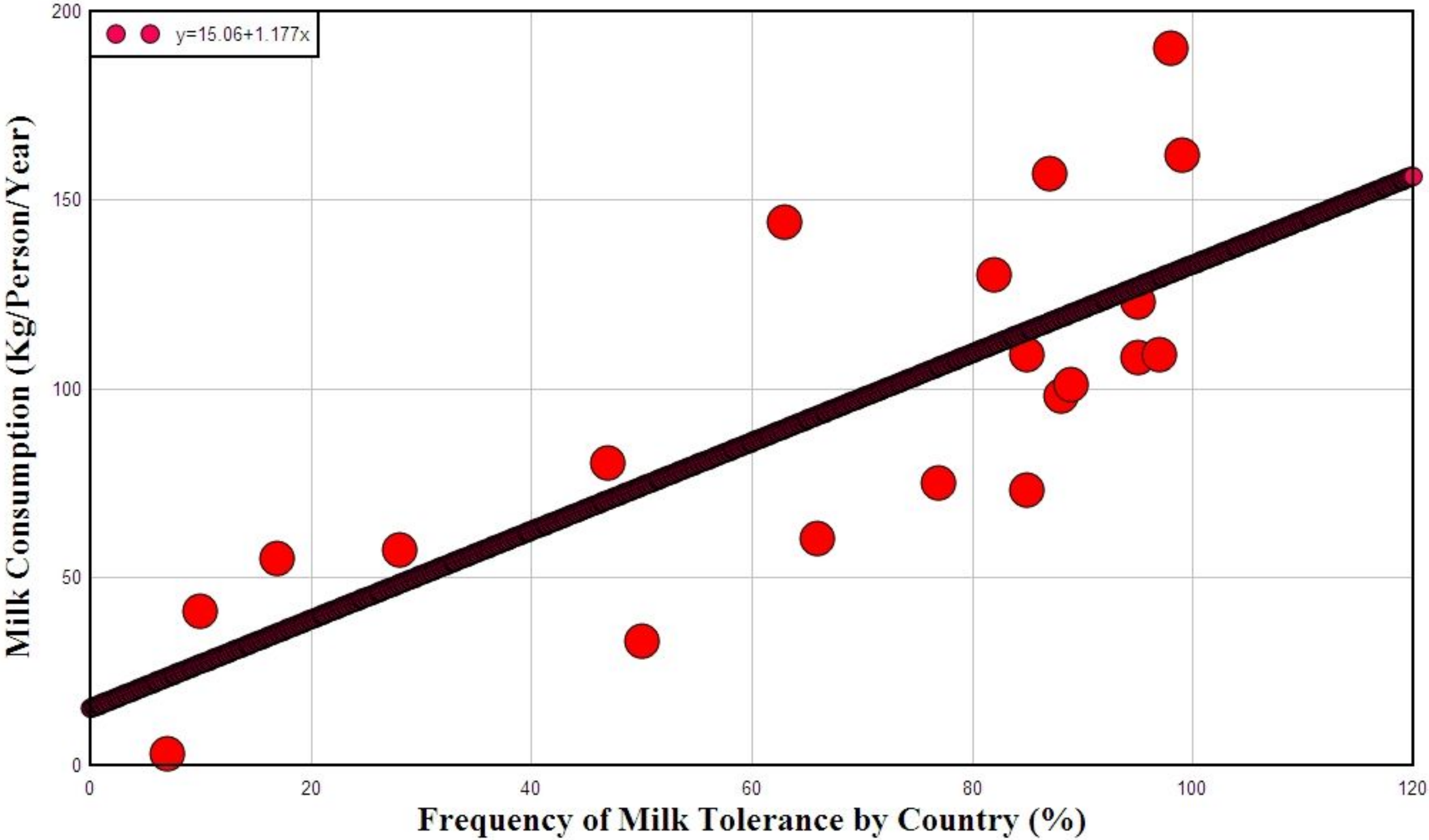

Table 1 Milk Consumption and Milk Tolerance for 20 Countries

Country	Milk Consumption Kg per person per year 1997, USDA	Percent Tolerance	Funnel Beaker Culture Area
Mexico	55	17	
United Stat	101	89	Descendents
Austria	157	87	Yes
Denmark	109	97	Yes
Finland	130	82	Yes
France	75	77	
Germany	73	85	Yes
Greece	80	47	
Ireland	190	98	Descendents
Italy	57	28	
Portugal	60	66	
Spain	109	85	
Sweden	162	99	Yes
United King	123	95	Descendents
Switzerland	98	88	
Poland	144	63	Yes
India	33	50	
Japan	41	10	
China	3	7	
Netherland	108	95	Yes