

Why do M&Ms melt in your mouth but not in your hand?

At first glance the answer to this questions may seem to be a very simple one - "The temperature in the mouth is greater than the temperature on the surface of the hand which causes the chocolate to melt once in the mouth and not in the hand." However, there is a lot more science behind this key Mars Confectionary unique selling point than initially observed.

Firstly let's look at the facts to determine why the above statement is incorrect.

To explain this we need to consider 3 factors:

1. Temperature inside the average M&M eater's mouth
2. Temperature of the surface of the skin
3. Melting Point of Chocolate.

1) In a healthy human, under no physical stress, skin temperature is almost wholly dependent on the surrounding environment – on cold windy days skin temperature will fall and on hot days or direct sunlight, skin temperature will rise. So we shiver or sweat to try to achieve thermo stasis. Furthermore, different parts of the body exhibit different levels of surface temperature. If you look at a thermal image of a person's head, invariably the temperature of the nose and ears will be lower than the other parts of the head. Therefore establishing the temperature of the surface of the palm is not an exact science as there are many variables to consider. However, various results have shown that the average humans palm temperature is around 32-35 degree C in normal conditions.

2) Internal body temperature is 37 degree C (98.6degree F). Not surprisingly, the temperature observed inside a healthy person's mouth is the same as that of the body (if you think about it – the mouth is just an extension of the esophagus and stomach – which would be at body temperature). That is why nurses can get an accurate reading of a person's temperature (and status of health) by taking a thermometer reading from the mouth. Rectal thermometers

work in the same way – your anus is just an extension of your colon and duodenum.

3) The melting point of chocolate is a tricky one also due to the many variables involved. It is dependent on additives, impurities, emulsifiers, various gelling agents and the types of alignment that the coca butter crystals form upon tempering during the manufacturing process. However, most commercially manufactured chocolate has a melting point between 16-37 °C – all slightly below that of body temperature (37 °C). It can therefore be stated that ALL chocolates will melt when put in the mouth and the MAJORITY will melt when held in the hand.

So why do M&Ms not melt in the hand? Is it because the melting point of chocolate is between the temperature of the hand (32-34 °C) and the temperature of the mouth (37 °C), meaning that the greater temperature of the mouth is what causes the melting in the M&M?

In a word – no. That is why the statement at the top of the page is incorrect. If this was the case, the chocolate would have to be made in such a specific way as to have a high melting point (just below that of the body, but above the skin) to allow for the varying temperatures found on the surface of the skin. Mars would have to make chocolate with a melting point around 36 degrees C – not an easy task (as mentioned, it's not an exact science) and in all probability it would not taste as nice as it currently does. In fact, the USP has nothing to do with the difference in the temperature between the surface of the skin and the inside of the mouth. In fact (BOMBSHELL ALERT!), the melting point of the chocolate in M&Ms is far lower than the temperature of the surface of the skin. Honest! Try it yourself at home - crack open your average M&M and scoop out the chocolate, place it on the palm of your hand, you will see that in a matter of seconds the chocolate will begin to melt... in your hand!!! Disaster!

So how come they don't melt when in your hand, yet quite happily melt when they are in your mouth??

The secret and the real science is in the crispy sugar coating (CSC) surrounding the chocolate in the M&Ms.

When you hold an M&M in your hand – you are not actually touching the chocolate directly – you are actually touching the crispy sugar coating surrounding the chocolate. This amazing glucose based coating works in 2 ways to stop the melting of the chocolate it surrounds. A) through its insulating properties and B) through its high melting point.

A) On the most basic level the crispy sugar coating is acting as an insulator (having a relatively low specific heat capacity) which prevents (or slows) the direct transfer of heat from the fingers/palm directly to the chocolate. This means that by the time you pop one in your mouth, the casing would have done its job and insulated the chocolate enough to prevent it melting in your hand.

B) The crispy sugar coating itself has a much higher melting point than the temperature of the skin. Therefore, the temperature of the skin will not melt the crispy sugar coating – keeping the chocolate inside safe from direct contact with the relatively high temperature of the skin.

So is that it? Not quite. Taking it one step further, we see that the CSC has a far higher melting point than that of chocolate and of the skin... and not only this... it has a far higher melting point than that of the temperature of the mouth!

This means it will not melt with direct contact with the skin (a good thing) but due to the high melting point, it will not even melt when in the mouth!! (“But, but, but... it does!” I hear you cry!!

Edited for grammar and content:

Why do M&Ms Melt in Your Mouth, but not in Your Hand? | Ask Science Gimp at JimmerUK.com. (2006, July 12). Retrieved September 22, 2014, from <http://www.jimmeruk.com/Ask-Science-Gimp/why-do-mams-melt-in-your-mouth-but-not-in-your-hand.html>

The melting point of the crispy sugar coating is so much higher than the inside of the mouth, that it would be impossible for anyone to melt the coating without simultaneously doing a fire breathing trick. Put a soft flame on an M&M next time you have a chance and see what happens... The chocolate inside will probably boil before the sugary crispy casing melts. Always use safety equipment and the ask for the supervision of an adult, keep away from oxidizing agents such as potassium nitrate – glucose can burn very violently in the right conditions.

So how come we don't have lots of crispy bits cutting up the inside of our mouth when we eat M&Ms if they cannot be melted? The CSC seems to melt with the chocolate?

In fact what is happening, is the sugar coating is not melting – it is dissolving!

Unlike chocolate, sugar is extremely soluble. The moment the CSC comes in contact with the moisture in our mouth, it begins to dissolve producing a sugary solute. This, in turn slowly diminishes the insulating layer (unless you chew the M&M), eventually exposing the chocolate. The chocolate in this warm environment then begins to melt.

This design is in fact a very ingenious scientifically perfect combination of low melting point, non-soluble substance protected from the ravages of skin temperature by the high melting point soluble and semi-insulating casing. The 2 substances create the ideal confectionery product by utilizing and exploiting the individual properties of the two substances in different environmental situations so that the snack remains in its intend state until it is consumed.