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A comparison of *in vitro* anti-cancer activity of different honey against the colon cancer cells

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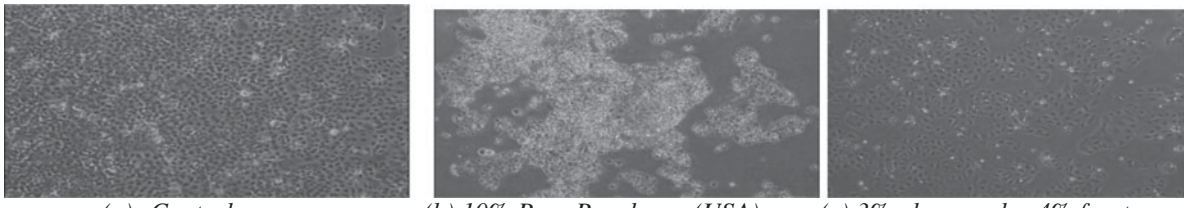
Colorectal cancer is the most common type of cancer in the Western countries. Our diet contains components that can increase or decrease the risk of cancer. Among these, red meat has been highlighted as a food that can increase the risk of colon cancer and fibre is suggested to be protective.[1] Foods with high antioxidant and anti-inflammatory activity are also suggested to be cancer preventive agents. Honey has been well known for its anti-inflammatory and antioxidant activity.[2]

In the present study, we set out to examine the anti-proliferative activity of six different honey including unprocessed Pure raw Bee flower & Sun honey (USA), three varieties of Manuka honey (Active 6+, Manuka 5^{+} and Manuka 15+), Australian Pure and Gale's commercial honey. Anti-proliferative activity of honey against Caco2 colon cancer cell lines was examined after 24 hour incubation with 10% honey using imaging and cell toxicity MTT assay. Percentage of viable cells in the MTT assay were calculated relative to cells grown in control media where the absorbance values in the presence of unsupplemented media were normalised to 100%. Since honey contains 30% glucose and 40% fructose, effect of 3% glucose and 4% fructose was also examined. Results from imaging and MTT assay are shown in figure 1 and table 1 respectively.



(a) Control *(b) 10% Pure Raw honey(USA)* *(c) 3% glucose plus 4% fructose*

Fig. 1. Images of caco2 cells incubated for 24 hours in unspplemented (a) and media containing 10% honey (b) and 3% glucose and 4% fructose (c).

Table 1. Caco2 cell viability in the presence of 10% final concentration of different honey

	Pure Raw (USA)	Rowse Manuka 5+	Active Manuka 6+	Rowse Manuka 15+	Australian Pure	Gales honey
Percent cell viability Mean (SD)	^{a}33.2 (3.9)	^{a}37.7 (2.3)	^{a}38.0 (4.3)	^{b}47.7 (1.1)	^{b}45.3 (5.4)	^{b}45.7 (4.3)

Results are average of experiments done on four different occasions with 5 replicates done at each time. Those not sharing a similar superscript were significantly different at $p<0.05$ (Mann Whitney test).

Results show reduction in caco2 cell viability in the presence of all honey, however unprocessed pure raw honey showed the highest effect. Percent cell viability was 89% in the presence of 3% final concentration of glucose, ~87% in the presence of fructose and ~70% in the presence of 3% glucose plus 4% fructose. In agreement with the previously published report[3] that discounted osmolarity changes being a significant factor in honey's anti-proliferative effects against the bladder cancer cell lines, our results show that other factors besides sugar are likely to contribute to honey's effect on cell viability. In our study, honey was also found to effect BrDu incorporation and distribution within the cell cycle., Flow cytometry analysis showed that compared to control, there was a significant reduction of cell number in G0/G1 phase ($P<0.005$) and increase in number of cells in the S phase ($P<0.05$).

In conclusions, results of present investigation highlight cancer interception potential of honey in an *in vitro* model of colon cancer cell line.

1. World Cancer Research Fund. (2009) Continuous update project report on colorectal cancer.
2. Kassim M *et al*. (2010) *Nutr Res* **30**(9): 650–9.
3. Swellam T *et al.* (2003) *Int J Urol* **10**(4): 213–9.