

Morus alba L. extracts inhibit adipocyte differentiation but stimulate lipolysis in 3T3-L1 cells

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Fruits of mulberry (*Morus alba* L.) belonging to the Moraceae family have been widely used for therapeutic purposes in Asian countries for centuries. Adipocyte differentiation has often been a target of anti-obesity strategies because obesity is caused not only by hypertrophy of adipocytes, but also by adipocyte hyperplasia⁽¹⁾. The 3T3-L1 cell line is commonly used as an adipocyte differentiation model system for investigation of molecular mechanisms that regulate adipogenesis⁽²⁾. This study was performed to investigate the effects of ethanol extract and fractions of *M. alba* L. on adipocyte differentiation in 3T3-L1 cells. The anti-adipogenic effect of *M. alba* L. extracts was examined for its effect on the anti-adipocyte differentiation of 3T3-L1 cells by Oil red O staining assay. The lipolysis effect of *M. alba* L. was measured by glycerol releases assay.

A

Treatment (Fraction)	Contents (µg/ml)	Intracellular TG accumulation (% of control)	Treatment (Fraction)	Contents (µg/ml)	Intracellular TG accumulation (% of control)
MDI		100 ± 12.2	MDI		100 ± 12.2
EtOH	10	113.5 ± 0.98	EA	10	103.3 ± 11.2
	25	112.7 ± 4.79		25	107.3 ± 0.8
	50	85.6 ± 1.88**		50	111.8 ± 14.4
	100	89.3 ± 10.0**		100	61.5 ± 4.4**
Hexan	10	124.5 ± 6.9	BuOH	10	103.5 ± 11.2
	25	113.6 ± 5.3		25	113.1 ± 1.0
	50	119.7 ± 7.6		50	120.5 ± 7.1
	100	78.4 ± 6.1*		100	91.8 ± 6.3
CHCl3	10	123.9 ± 8.6	H2O	10	105.4 ± 5.2
	25	125.6 ± 0.5		25	114.1 ± 0.6
	50	128.0 ± 12.8		50	113.8 ± 6.9
	100	76.1 ± 9.3*		100	110.0 ± 6.0

B

Treatment (Fraction)	Contents (µg/ml)	Glycerol released to medium (µg/ml)	Treatment (Fraction)	Contents (µg/ml)	Glycerol released to medium (µg/ml)
MDI		6.56 ± 0.23	MDI		5.61 ± 0.14
EtOH	10	6.50 ± 0.43	EA	10	5.66 ± 0.13
	25	6.75 ± 0.44		25	5.49 ± 0.12
	50	6.82 ± 0.17		50	5.33 ± 0.05*
	100	6.56 ± 0.77		100	5.53 ± 0.22
Hexan	10	5.46 ± 0.91	BuOH	10	5.58 ± 0.10
	25	4.55 ± 0.20*		25	5.43 ± 0.07
	50	4.97 ± 0.53**		50	5.10 ± 0.92
	100	3.63 ± 0.36**		100	5.15 ± 0.45
CHCl3	10	5.22 ± 0.93	H2O	10	5.30 ± 0.15
	25	3.91 ± 0.43**		25	5.34 ± 0.31
	50	4.19 ± 1.11**		50	5.60 ± 0.46
	100	4.41 ± 0.20**		100	5.60 ± 0.25

Values are means for three independent experiments. Mean values were significantly different from those for MDI group (ANOVA, followed by Duncan test): * $P < 0.05$, † $P < 0.01$.

Treatment of 3T3-L1 cells with ethanolic extracts of *M. alba* decreased adipocyte differentiation in a dose-dependent manner (A). Most of the tested fractions exhibited anti-adipogenic effects except for butanol and water-soluble fractions. The ethylacetate-soluble fraction was found to have the greatest inhibitory effect, as indicated by suppression of the lipid accumulation by 38.5% in response to treatment with 100 µg/ml.

On other hands, glycerol secretion decreased in treated-concentration of hexan and chloroform-soluble fraction. The low secretion level of glycerol is not an expected result because it was thought that adipocyte reducing effects are caused by lipolysis. The results indicate that *M. alba* L. is a possible candidate for regulating lipid accumulation in obesity.

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- Jae Eun K & Jie C (2004) *Diabetes* 53, 2748–2756.