Proceedings of the International Conference on Nursing and Health Sciences, Volume 4 No 1, January - June 2023
e-ISSN 2774 – 5104, Global Health Science Group
http://jurnal.globalhealthsciencegroup.com/index.php/PICNHS

THE EFFECT OF BAMBOO TALI LEAF TEA ON LEPTIN LEVELS IN RATS METABOLIC SYNDROME

Ani Rosa Putri Ayu Mujayanah[1*], Yulia Sari[2], Shanti Listyawati[3]
[1]Department of Clinical Nutrition, Postgraduate Program, Sebelas Maret University, Ir. Sutami No. 36, Surakarta, 57126, Central Java, Indonesia
[2]Department of Parasitology, Faculty of Medicine, Sebelas Maret University, Ir. Sutami No. 36, Surakarta, 57126, Central Java, Indonesia
[3]Department of Biology, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Ir. Sutami No. 36 Surakarta, 57126, Central Java, Indonesia
*anirosa385@gmail.com

ABSTRACT

Metabolic syndrome is a threat to health problems in the world, namely a group of metabolic disorders that occur simultaneously. Obesity is a risk factor for metabolic syndrome. Fat accumulation causes insulin resistance and leptin resistance resulting in weight gain. Tali bamboo leaf tea contains a natural source of antioxidants that can increase insulin sensitivity so that it can reduce leptin levels. This study aims to determine the effect of bamboo tali leaf tea on leptin levels in rats with metabolic syndrome. This type of research is experimental laboratoric with a Pre-Post Test with a Control Group design. Wistar male white rats, 8 weeks old, and 150 – 250 grams in weight, were fed HFHF (High Fat High Fructose) for 14 days, induced by Nicotinamide and Streptozotocin. Then, the rats were divided into 5 groups, namely negative control, positive control, and 3 treatments of tali bamboo leaf tea (300, 600, and 900 mg/200 g BW) for 28 days. Measurement of leptin levels using the ELISA method.Bamboo leaf tea had a significant effect ($p < 0.005$) on leptin levels in rats with metabolic syndrome. The largest decrease in leptin levels occurred in the TDB3 group which was 82.8% and the lowest decrease in leptin levels occurred in the TDB1 group which was 34.8%. Bamboo leaf tea doses of 300, 600, and 900 mg/200 g BW reduced leptin levels in rats with metabolic syndrome for 28 days.

Keywords: bamboo leaf tea; leptin; metabolic syndrome; obesity; wistar

INTRODUCTION

A metabolic syndrome is a group of metabolic disorders such as hypertension, obesity, hyperglycemia, and dyslipidemia that occur simultaneously resulting in disruption of metabolic processes (Barorah & Maslikhah, 2021). According to the IDF, the prevalence of metabolic syndrome globally is 20 – 25% and is expected to increase to 53% by 2035 (IDF, 2018). In Indonesia, prevalence of metabolic syndrome is 23,3% of the total population, where it occurs more in women, namely 46% and in men 28% (Sigit *et al*., 2020).

Obesity is a risk factors for metabolic syndrome (Harahap *et al*., 2021). Obesity is a condition resulting from an imbalance energy. Excess energy intake will be stored as fat, causing abnormal fat accumulation in adipose tissue (Thahir & Masnar, 2021). Excessive accumulation of body fat causes lipid deposition and produces lipotoxicity which causes insulin resistance (Tong *et al*., 2022). Fat accumulation can produce adipocytokine hormones such as adiponectin and leptin. Leptin is a hormone to regulate energy balance which functions to inhibit hunger (Kumar *et al*., 2020). Insulin resistance causes leptin resistance. Insulin functions to convert glucose into energy. If there is excess glucose, it will be converted into fat and will release the hormone insulin. The more glucose is released, the more insulin will be produced and the more fat will be formed. This condition causes the body to be unresponsive and causes insulin resistance which can inhibit leptin's performance in delivering satiety signals to the brain. This is because cells do not receive

glucose, which causes the body to feel the need for energy nd to feel constantly hungry (Nikmah & Dany, 2017).

Tali bamboo leaves contain natural sources of antiocidants such as flavonoids, lactones, phenolic acids, alkaloid, phenols, tannin, and saponin which can incease leptin sensitivity. Fresh tali bamboo leaves contain 5,57 g/100 g of flavonoids, 0,12 g/100 g of alkaloids, 72,09 mg/100 g of tannins, and 27,2 g/100 g of fiber (Romansyah *et al*., 2019). Flavonoids can potect pancreatic β cells, improve and increase insulin sensitivity so that they can help incease insulin sensitivity. In addition, tannins and saponins play a role in increasing the permeability of the small intestine mucosa, inhibiting the active transport of nutrients and reducing appetite to lose weight (Patonah *et al*., 2017). This study aims to determine the effect of giving tali bamboo leaf tea on leptin levels in rats with metabolic syndrome.

METHOD

This research is a laboratory experimental study with a pre-posttest control group design. This research was conducted in January – March 2023 in the of the Center for Food Studies and Nutrition (PSPG) at Gadjah Mada University. This research was approved by the Commission Faculty Ethics Sebelas Maret University Medicine (KEPK FK UNS) with No. 20/UN27.06.11/KEP/EC/223. The tools and materials for this research were animal cages, ovens, scales, intraperitoneal injection syringes, gastric probes, syringes, ELISA kits (Elisa microplate, Lyophilized standard, Sample, standard dilution buffer, Biotin-labeled antibody6(Lyophilized), Purified water, Antibody dilution buffer, HRP-Streptavidin Conjugate, SABC Dilution Buffer, TMB Substrate, ELISA Stop solution, Wash buffer), Wistar rats, comfeed, husks, string bamboo leaves, distilled water, alcohol, cotton, tissue, metformin, HFHF (High Fat High Fructose) feed, Streptozotocin and nicotinamide. The manufacture HFHF (High Fat High Fructose) diet consists of a mixture of 32 grams of Comfeed feed, 28 grams of duck egg yolk, 40 grams of beef tallow, and 12 grams of chicken liver and butter. In addition, also given 10% fructose (Zarghani et al., 2016).

Tali bamboo leaf tea is made, namely fresh bamboo tali leaves, dark green in color, without spots, and located in the order of 3 – 4 of the shoots, washed, sorted, aired, then cut and dried in an oven at 70^{o}C until dry and then blended until smooth. Tali bamboo leaf tea is brewed with hot water that has been boiled (100^{o}C) for 10 minutes and left to cool. The infusion of bamboo leaf tea was given to rats using a stomach tube. he sample for this study was 30 white rats (Rattus norvegicus) Wistar strain, male, 8 weeks old, and 150 – 250 grams in weight. Wistar rats adapted for 7 days. After adaptation, the rats were randomized and divided into 5 groups, namely the negative control group, the positive control group, and the 3 groups treated with tali bamboo leaf tea. After randomization, the rats were made into metabolic syndrome by being given an HFHF (High Fat High Fructose) diet for 14 days, then induced by 110 mg/Kg BW of nicotinamide and 45 mg/Kg BW of streptozotocin and adapted for 3 days. After the rats developed metabolic syndrome, blood was taken using the retro-orbital plexus method through the sinus orbitalis to check leptin levels before treatment (pretest). Furthermore, rats were treated, namely the negative control group (given distilled water), positive control (given metformin 9 mg/200 g BW rats), TDB1 group (given bamboo leaf tea at a dose of 300 mg/200 g BW rats), TDB2 (given bamboo leaf tea rope dose of 600 mg/200 g BW rats) and TDB3 (given bamboo leaf tea at a dose of 900 mg/200 g BW rats) for 28 days. On the 29th day, blood was taken to check leptin levels after treatment (posttest).

Examination of leptin levels using the Rat Leptin Elisa Kit method. Blood was centrifuged at 3500 rpm at 4^{o}C for 10 minutes. The supernatant was taken and centrifuged at 3500 rpm, 4^{o}C for 5 minutes. Then stored at – 80^{o}C. Plasma was diluted 3 times in a 1:2 ratio using diluent buffer D. The leptin test procedure was the same as for insulin levels. Then, serum and blood plasma were diluted 3 times (1 : 2) using sample diluent buffer D and also dilution of a standard solution made from a solution with a concentration of 50 ng/ml. the absorbance value of the sample was read on a λ 450 nm spectrophotometer.The research results were analyzed using SPSS version 16.0. Data were analyzed using paired t-test and ANOVA, followed by a post hoc with a p-value <0.05.

RESULTS AND DISCUSSION

Obesity is one of the main causes of metabolic syndrome. Obesity is a condition resulting from an energy imbalance where energy intake is greater than energy expenditure which causes a positive energy balance (Thahir & Masnar, 2021). Apart from food intake, hormones also play a role in regulating balance, one of which is leptin. Leptin is related to BMI. According to Sumadewi (2017), if there is an increase in BMI of 1 Kg/m2, it will cause leptin levels to increase by 0.549. Obese sufferers are at risk of having leptin 4.6 times higher than people who have normal BMI (Nikmah & Dany, 2017). Obesity sufferers usually have high leptin levels because they have many fat cells so they will also produce a lot of leptin. However, obese people often fail to control their hunger and have difficulty limiting their intake, this condition is called leptin resistance. This is due to the disruption of leptin transport to the brain so that the hypothalamus becomes deficient in leptin. Leptin has an important role as a metabolic switch to regulate energy homeostasis (Cahyaningrum, 2015).

Tali bamboo leaf tea (*Gigantochloa apus Kurz*.) is a herbal drink that is not made from Camellia synesis tea leaves which are made through a drying process (Lagawa *et al.,* 2020). Tali bamboo leaves contain a natural source of antioxidants that can be used to treat various health problems, one of which is anti-obesity (Novitasari, 2015). The antioxidants contained in the leaves of the bamboo rope include flavonoids, tannins, saponins, alkaloids, phenolic acids, and many more. Flavonoid compounds contained in bamboo leaves are flavones C-glycosides such as orientin, isoorientin, vitexin, and homovitexin, phenolic compounds of bamboo leaves such as p-coumaric acid, chlorogenic acid, ferulic acid, and chlorogenic acid (Made *et al*., 2021). The following is the average result of leptin level examination in rats with metabolic syndrome:

Table 1 shows that there was a significant difference (p <0.05) between before treatment (day 1) and after treatment (day 29). This shows that there is an effect of giving tali bamboo leaf tea on leptin levels in rats with metabolic syndrome. To see the differences between groups, the One Way ANOVA test was carried out, where the ANOVA results showed that there were significant differences (p <0.05) between the treatment groups, both in the control group and the treatment group. However, in the pre-treatment group, it showed that there was no significant difference between the control group and the treatment group. This is because the mice are in a healthy condition or have not been made into metabolic syndrome.

Table 1.
Mean Examination of Leptn Levels in Rats with Metabolic Syndrome

Group	n	Mean Leptin Levels (ng/ml)

		Day 1 (mean ± SD)	Day 29 (mean ± SD)	ΔGDP (mean ± SD)	Pa
Negative Control	6	11.08 ± 0.56	11.31 ± 0.53	0.23 ± 0.08	<0.001*
Positive Control	6	11.14 ± 0.53	2.71 ± 0.37	-8.43 ± 0.27	<0.001*
TDB1 group	6	10.92 ± 0.52	7.13 ± 0.32	-3.80 ± 0.64	<0.001*
TDB2 group	6	10.80 ± 0.51	3.15 ± 0.52	-7.65 ± 1.00	<0.001*
TDB3 group	6	10.98 ± 0.40	1.88 ± 0.16	-9.10 ± 0.48	<0.001*
Pb		0.789	0.000*	0.000*	

Description: Δ Leptin levels: the difference between leptin levels between day 29 (end of intervention) and day 1 (after induction of metabolic syndrome and before intervention), *) There is a significant difference (p <0.05), a) paired t statistical test H1 test with H29, b) One Way Anova statistical test

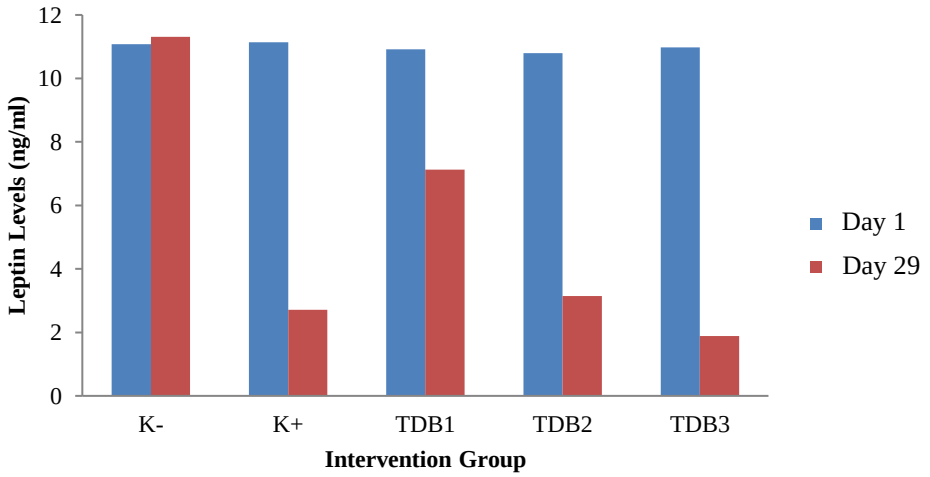

Figure 1. Effect of Giving Bamboo Tali (Gigantochloa apus Kurz.) Leaf Tea on Leptin Levels in Rats with Metabolic Syndrome

Figure 1 shows that after 28 days of treatment, the negative control group experienced an increase in leptin levels. This is different from the positive control group and the treatment group which showed a decrease in leptin levels. The greatest decrease in leptin levels occurred in the treatment group given bamboo leaf tea at a dose of 900 mg/200 g BW of rats, which was 82.8% (9.10 ± 0.48) compared to the positive control group and the bamboo leaf tea treatment group. rope dose of 300 and 600 mg/200 g BW rats. The positive control group experienced a decrease in leptin levels by 75.67% (8.43 ± 0.27), and the treatment group that was given bamboo leaf tea at a dose of 600 mg/200 g BW experienced a decrease in leptin levels by 70.8% (7.65 ± 1,00), and the lowest decrease in leptin levels occurred in the treatment group that was given bamboo leaf tea at a dose of 300 mg/200 g BW, which was 34,8% (3,8 ± 0,64).

Table 2.
LSD Post-hoc Analysis Effect of Bamboo Tali Leaf Tea on Leptin Levels in Mice with Metabolic Syndrome

Group	Treatment	P
K-	K+	<0.001*
	TDB1	<0.001*
	TDB2	<0.001*
	TDB3	<0.001*
K+	TDB1	<0.001*
	TDB2	0.030*
	TDB3	0.059
TDB1	TDB2	<0.001*
	TDB3	<0.001*
TDB2	TDB3	<0.001*

Information:
K - : Negative control (given the test material solvent (aquades))
K+ : Control positive (given metformin 9 mg/200 g BW)
TDB1 : Bamboo tali leaf tea dose of 300 mg/200 g BW
TDB2 : Bamboo tali leaf tea dose of 600 mg/200 g BW
TDB3 : Bamboo tali leaf tea dose of 900 mg/200 g BW
P : LSD Post Hoc Test
* : There is a significant difference between the treatment groups

Table 2 shows that there was a significant difference between the treatment groups, except for the positive control group and the TDB3 group (giving bamboo leaf tea at a dose of 900 mg/200 g BW) which showed no significant difference, this means that giving leaf tea bamboo rope dose of 900 mg/200 g BW has almost the same effect as metformin on reducing leptin levels in rats with metabolic syndrome. Metformin is an antidiabetic drug that works by reducing glucose production in the liver and repairing muscle glucose. In addition, metformin can reduce weight by stimulating hypothalamic neurons, increasing leptin and insulin sensitivity, increasing GLP-1, and modulating intestinal flora which can lead to decreased food intake (Feng *et al.*, 2017).

Tali bamboo leaf tea can reduce leptin levels in rats with metabolic syndrome because Tali bamboo leaves contain natural antioxidant compounds such as flavonoids, phenolic acids, alkaloids, saponins, and tannins which can increase leptin sensitivity and reverse leptin resistance in people with obesity and diabetes mellitus (Pérez-Pérez *et al.*, 2020). Flavonoids act as immune response modulators that can inhibit transcription factors involved in various pro-inflammatory genes such as the leptin gene. Phenolic compounds such as flavones, flavonols, anthocyanins, and phenolic acids can reduce leptin levels and reduce food intake by increasing the content of phospho-STAT3 in the hypothalamus to increase leptin sensitivity (Ardid-Ruiz *et al.*, 2018; Pérez-Pérez *et al*., 2020). Flavonoids can protect pancreatic β cells, improve and increase insulin sensitivity in cells, thereby increasing leptin sensitivity. In addition, tannins and saponins play a role in increasing the permeability of the small intestine mucosa, inhibiting the active transport of nutrients, and reducing appetite to lose weight (Patonah *et al*., 2017). Tannins have been shown to play a role in overcoming obesity by suppressing food intake and increasing energy expenditure by mediating leptin levels (Chen *et al*., 2019).

The results of this study are in accordance with the research Xu *et al* (2015) which showed that giving green tea extract at a dose of 800 mg/Kg BW could reduce leptin levels in rats fed a high-fat diet. This is because green tea extract contains polyphenols which can reduce leptin levels. In addition, black tea containing 0.09% ECG can reduce food intake by improving leptin resistance. Leptin is a hormone that can influence energy intake, energy expenditure, body weight, and neuroendocrine function through action on nerve targets in the hypothalamus (Jin *et al*., 2013).

CONCLUSION

Tali bamboo leaf tea significantly reduced leptin levels in rats with metabolic syndrome at doses of 300, 600, and 900 mg/200 g BW rats. The greater the dose of tali bamboo leaf tea given, the greater the effect on lowering leptin levels. The optimal dose of tali bamboo leaf tea to reduce leptin levels is 900 mg/200 g BW.

REFERENCES

Ardid-Ruiz, A., Ibars, M., Mena, P., Del Rio, D., Muguerza, B., Bladé, C., Arola, L., Aragonès, G., & Suárez, M. (2018). Potential involvement of peripheral leptin/STAT3 signaling in the effects of resveratrol and its metabolites on reducing body fat accumulation. *Nutrients*, *10*(11), 1–16. https://doi.org/10.3390/nu10111757

Barorah, I., & Maslikhah. (2021). *Buku Ajar Gizi Dalam Kesehatan Reproduksi*. PT. Nasya Expanding Management.

Cahyaningrum, A. (2015). Leptin sebagai indikator obesitas, Sandubaya Mataram. *Jurnal Kesehatan Prima*, *I*(1), 1364–1371.

Chen, F., Wang, H., Zhao, J., Yan, J., Meng, H., Zhan, H., Chen, L., & Yuan, L. (2019). Grape seed proanthocyanidin inhibits monocrotaline-induced pulmonary arterial hypertension via attenuating inflammation: in vivo and in vitro studies. *Journal of Nutritional Biochemistry*, *67*, 72–77. https://doi.org/10.1016/j.jnutbio.2019.01.013

Feng, W., Gao, C., Bi, Y., Wu, M., Li, P., Shen, S., Chen, W., Yin, T., & Zhu, D. (2017). Randomized trial comparing the effects of gliclazide, liraglutide, and metformin on diabetes with non-alcoholic fatty liver disease. *Journal of Diabetes*, *9*(8), 800–809. https://doi.org/10.1111/1753-0407.12555

Harahap, H., Kusdiyah, E., Mhd Usni Zamzami, H., Harahap, A. H., & Malau, M. Y. R. (2021). Efek Intermittent Fasting Tipe 5:2 Terhadap Asam Urat dan Lingkar Pinggang Individu dengan Overweight dan Obesitas. *Jambi Medical and Health Sciences*, *000*(Special Issues), 409–417.

IDF. (2018). The IDF Consensus Worldwide Definition of The Metabolic Syndrome. In *IDF Communications* (Vol. 28, Issue 1). https://doi.org/10.1159/000282084

Jin, D., Xu, Y., Mei, X., Meng, Q., Gao, Y., Li, B., & Tu, Y. (2013). Antiobesity and lipid lowering effects of theaflavins on high-fat diet induced obese rats. *Journal of Functional Foods*, *5*(3),

1142–1150. https://doi.org/10.1016/j.jff.2013.03.011

Kumar, R., Mal, K., Razaq, M. K., Magsi, M., Memon, M. K., Memon, S., Afroz, M. N., Siddiqui, H. F., & Rizwan, A. (2020). Association of Leptin With Obesity and Insulin Resistance. *Cureus*, *12*(12), 19–22. https://doi.org/10.7759/cureus.12178

Lagawa, I. N. C., Kencana, P. K. D., & Aviantara, I. G. N. A. (2020). Pengaruh Waktu Pelayuan dan Suhu Pengeringan terhadap Karakteristik Teh Daun Bambu Tabah (Gigantochloa nigrociliata BUSE-KURZ). *Jurnal BETA (Biosistem Dan Teknik Pertanian)*, *8*(2), 223. https://doi.org/10.24843/jbeta.2020.v08.i02.p05

Made, N., Wahyuni, S., Wrasiati, L. P., & Hartiati, A. (2021). Analisis Korelasi Antara Kandungan Senyawa Bioaktif dengan Aktivitas Antioksidan pada Ekstrak Daun Bambu Duri (Bambusa blumeana). *Agrointek, Jurnal Teknologi Industri Pertanian*, *15*(4), 1062–1070. https://doi.org/10.21107/agrointek.v15i4.9853

Nikmah, U. A., & Dany, F. (2017). Kadar Leptin sebagai Petanda Diabetes pada Individu dengan Diabetes dan Toleransi Glukosa Terganggu. *Buletin Penelitian Kesehatan*, *45*(3), 1–6. https://doi.org/10.22435/bpk.v45i3.6508.145-152

Novitasari, A. (2015). Pengaruh Ekstrak Daun Bambu Tali (Gigantochloa apus (Schult. & Shult. f.) Kurz.) Terhadap Penurunan Kadar Asam urat Darah Mencit Jantan Balb-C (Mus musculus L.) Hiperurisemia dan Pemanfaatannya Sebagai Karya Ilmiah Populer. *Digital Repository Universitas Jember*, 1–56. http://repository.unej.ac.id/bitstream/handle/123456789/75992/Dian Pratiwi - 132310101064 -1.pdf?sequence=1

Patonah, Susilawati, E., & Riduan, A. (2017). Aktivitas Antiobesitas Ekstrak Daun Katuk (Sauropus androgynus L. Merr). *Pharmacy*, *14*(1), 43. https://doi.org/10.1017/CBO9781107415324.004

Pérez-Pérez, A., Vilariño-García, T., Guadix, P., Dueñas, J. L., & Sánchez-Margalet, V. (2020). Leptin and nutrition in gestational diabetes. *Nutrients*, *12*(7), 1–18. https://doi.org/10.3390/nu12071970

Romansyah, E., Sinthia Dewi, E., Suhairin, S., Muanah, M., & Ridho, R. (2019). Identifikasi Senyawa Kimia Daun Bambu Segar Sebagai Bahan Penetral Limbah Cair. *Jurnal Agrotek Ummat*, *6*(2), 77. https://doi.org/10.31764/agrotek.v6i2.1219

Sigit, F. S., Tahapary, D. L., Trompet, S., Sartono, E., Willems Van Dijk, K., Rosendaal, F. R., & De Mutsert, R. (2020). The prevalence of metabolic syndrome and its association with body fat distribution in middle-aged individuals from Indonesia and the Netherlands: A cross-sectional analysis of two population-based studies. *Diabetology and Metabolic Syndrome*, *12*(1), 1–11. https://doi.org/10.1186/s13098-019-0503-1

Sumadewi, K. T. (2017). Korelasi Antara Kadar Leptin dengan IMT, Lingkar Pinggang dan RLPP pada Orang Dewasa Obesitas Usia 19-25 Tahun di Universitas Warmadewa. *WMJ (Warmadewa Medical Journal)*, *1*(2), 71. https://doi.org/10.22225/wmj.1.2.30.71-82

Thahir, A. I. A., & Masnar, A. (2021). *Obesitas Anak dan Remaja: Faktor Risiko, Pencegahan, dan Isu Terkini*. Edugizi Pratama Indonesia. https://books.google.co.id/books?id=L8owEAAAQBAJ

Tong, Y., Xu, S., Huang, L., & Chen, C. (2022). Obesity and insulin resistance: Pathophysiology and treatment. *Drug Discovery Today*, *27*(3), 822–830. https://doi.org/10.1016/j.drudis.2021.11.001

Xu, Y., Zhang, M., Wu, T., Dai, S., Xu, J., & Zhou, Z. (2015). The anti-obesity effect of green tea polysaccharides, polyphenols and caffeine in rats fed with a high-fat diet. *Food and Function*, *6*(1), 297–304. https://doi.org/10.1039/c4fo00970c