Effect of Harvesting Time On Rhizome, Volatile Oil and Xanthorrhizol Yield of Four Temulawak (Curcuma xanthorrhiza roxb.) Accessions

Conference Paper · December 2011

4 authors, including:

Lukita Devy
Badan Pengkajian dan Penerapan Teknologi

NADIA DWI KARTIKA
Badan Pengkajian dan Penerapan Teknologi

Effect of Harvesting Time On Rhizome, Volatile Oil and Xanthorrhizol Yield of Four Temulawak (*Curcuma xanthorrhiza* roxb.) Accessions

Lukita Devy, Arief Arianto, Armelia Tanjung, Nadia Dwi Kartika

Agency for the Assessment and Application of Technology (BPPT), Jakarta, Indonesia
BPPT 2nd Building, 17th Floor, Jl. MH Thamrin 8 Jakarta 10340
E-mail: lukita@webmail.bppt.go.id; Tel: +62-21-3169611, Mobile: +62-81310383033

ABSTRACT

Temulawak rhizome is an important ingredient in Indonesian 'jamu' because of its various benefits. Rhizome, volatile oil and xanthorrhizol yield became quantity and quality indicators of temulawak. The objective of this research was to study the effect of harvesting time on rhizome, volatile oil and xanthorrhizol yield of four temulawak accessions. The experiment was conducted at Puspiptek Serpong, Tangerang in 2010. Randomized complete block design was used with two factors and three replications. The first factor was harvesting time (7, 8 and 9 months after planting), the second factor was temulawak accessions (T4, T11, Cursina 1 and Ungaran local variety). The results showed that the interaction between harvesting time and temulawak accessions affected rhizome dry weight. The highest dry weight was shown by accession T11 on 9 months (368.41 g/plant). Harvesting time affected volatile oil content, rhizome fresh weight, rhizome water content and rhizome rendemen. Volatile oil content and rhizome water content was decreasing with the increasing of harvesting time, but the rendemen was increasing. The highest volatile oil content was at 7 months (5.88%). Rhizome fresh weight was highest at 8 months (1206.3 g/plant) then decreasing at 9 months (839.6 g/plant). Accessions showed different responds in volatile oil yield, rhizome fresh weight, rhizome water content and rhizome rendemen. The highest volatile oil yield (1628.2 ml/plant), rhizome fresh weight (1494.4 g/plant), rhizome dry weight (295.16 g/plant) and rhizome water content (79.9%) were shown by T11. High water content of T11 produced low rendemen, but its dry weight was still the highest among four accessions tested. Harvesting time, temulawak accessions and their interaction were not affected xanthorrhizol content and xanthorrhizol yield.

Keywords: dry weight, fresh weight, temulawak, volatile oil, xanthorrhizol.

INTRODUCTION

Temulawak as one of Indonesian traditional medicinal plant is widely used in various jamu ingredients. It showed many advantages for pharmacology, functional food and cosmetics purposes. Those functions were supported by the bioactive compounds of the plant rhizomes.

Generally temulawak bioactive compounds were consisted of curcuminoid, volatile oil and starch fraction (LP Unpad 1985). Volatile oil in temulawak was one of sesquiterpenoid ketone derivatives (Wardini and Prakoso *in* de Padua, Bunyapraphatsara & Lemmens 1999). Volatile oil, as one of the important products of temulawak, consisted of five major compounds and eight minor compounds (Agusta & Chairul 1996). Some of those major compounds were ar-curcumene, xanthorrhizol, α-, β-curcumene and germacrene (Wardini and Prakoso *in* de Padua, Bunyapraphatsara & Lemmens 1999).

Xanthorrhizol, as one of the major constituent in volatile oil, was proven for its advantages in pharmacological and chemical industries. Those were proven as broad spectrum antifungi, antibacterial, anti tumor metastatic and chemotherapy side effects preventor (Kim *et al.* 2008; Rukayadi *et al.* 2008; Choi *et al.* 2004; Kim *et al.* 2005; Rukayadi *et al.* 2006). In industry, temulawak was potential for oral care, acne treatment and anti dandruff (Hwang *et al.* 2008).

Some of many factors that might affect temulawak quality and quantity were harvesting time and genetic potential. Ghulamahdi *et al.* (2008) reported that the highest temulawak curcuminoid and xanthorrhizol contents were achieved at 9 months after planting. However, Khaerana (2008) mentioned that temulawak xanthorrhizol content was highest at 7 months after planting. Another research on ginger harvesting time showed that volatile oil content was highest at 7 months after planting (Nurliana *et al.* 2010). Therefore, more investigations on appropriate harvesting time will be useful information for temulawak quality improvement.

The contribution of genetic potential in plant yield and quality is un-doubtful. Each germplasms has unique characters. Considering that environmental effect, such as harvesting time, combined with temulawak genetic potential would produce specific effect on its yield and quality, this study was undertaken to identify the effect of harvesting time on rhizome, volatile oil and xanthorrhizol yield of four temulawak accessions.

ISBN No. 978-979-25-1209-0

MATERIALS AND METHODS

The experiment was conducted at Center for Agricultural Production Technology-BPPT, Puspiptek Serpong, Banten from December 2009 -September 2010 (67 m above sea level). The field trial was arranged in a Randomized Complete Block Design with two factors and three replications. The first factor was three harvesting time (7, 8 and 9 months after planting) and the second factor was four temulawak accessions (T4, T11, Cursina1 and Ungaran local variety). Accessions T4 and T11 were temulawak promising lines of BPPT, while Cursina1 was a released temulawak variety of The Ministry of Agriculture.

Sprouted rhizomes were sown in 70 cm x 60 cm spacing. Manuring 1 kg, SP-36 (P_2O_5 36%) 8.4 g per plant, KCl 8.4 g + Urea 2.8 g per plant (1/3 doses) were given when planting. Urea 2.8 g per plant was also given at one and two months after planting. The methodology referred to Temulawak Standard Operational Procedure (Rahardjo & Rostiana 2005).

Observations were performed on xanthorrhizol content, xanthorrhizol yield, volatile oil content, volatile oil yield, rhizome fresh weight, rhizome dry weight, rhizome water content and rhizome rendemen. Xanthorrhizol yield or volatile oil yield is a function of dry weight by xanthorrhizol content or volatile oil content. Xanthorrhizol content was measured by HPLC method and volatile oil content by distillation method.

Data were analyzed with Analysis of Variance (Gomez & Gomez 1995). Duncan Multiple Range Test was also used for data comparison.

RESULTS AND DISCUSSIONS

The results showed that the interaction between harvesting time and temulawak accessions only affected rhizome dry weight (Table 1). The highest dry weight (Figure 1) showed by accession T11 on 9 months (368.41 g/plant).

Table **1**. Analysis of Variance Result

Variable	Mean Square Error		
	Accessions (A)	Time (T)	A x T
Volatile Oil Content	0.49 ns	3.48 **	0.60 ns
Xanthorrhizol Content	0.14 ns	0.09 ns	0.55 ns
Rhizome Fresh Weight	878258 **	405833 **	105324 ns
Rhizome Dry Weight	14866 *	19462 **	10065 *
Volatile Oil Yield	659763 *	95696 ns	338953 ns
Xanthorrhizol Yield	4180 ns	3784 ns	7555 ns
Water Content	70 *	180 **	26 ns
Rendement	70 *	180 **	26 ns

Note:
** = siginificant at α=1%;
* = iginificant at α=5%,
ns = not significant

Tested accessions showed different response on volatile oil yield, rhizome fresh weight, rhizome dry weight, rhizome water content and rhizome rendemen. However, harvesting time affected volatile oil content, rhizome fresh weight, rhizome dry weight, rhizome water content and rhizome rendemen (Table 1).

The highest volatile oil yield (368.41 ml, Figure 1), rhizome fresh weight (1494.4 g/plant, Figure 4), rhizome dry weight (295.16 g/plant, Figure 4) and rhizome water content (79.9%, Figure 5) were shown by T11. High water content of T11 produced low rendemen (Figure 6), but its dry weight was still the highest among four accessions tested.

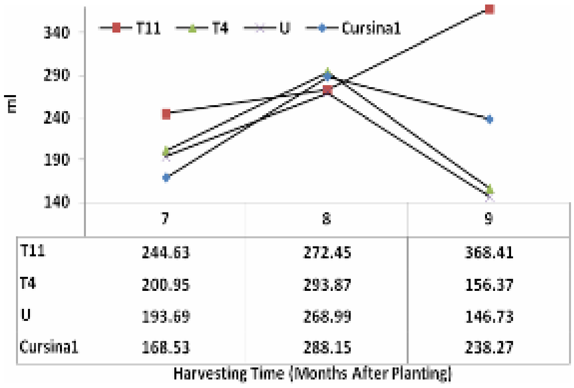

Figure **1**. Interaction between harvesting time and four temulawak accessions affected volatile oil content and rhizome fresh weight

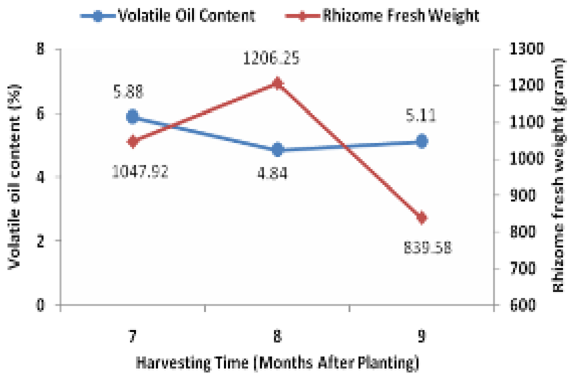

Figure **2**. Effect of harvesting time on volatile oil content and rhizome fresh weight of temulawak

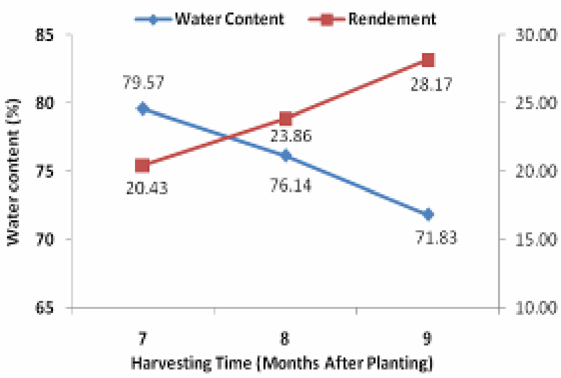

Figure **3**. Effect of harvesting time on water content and rendement of temulawak

ISBN No. 978-979-25-1209-0

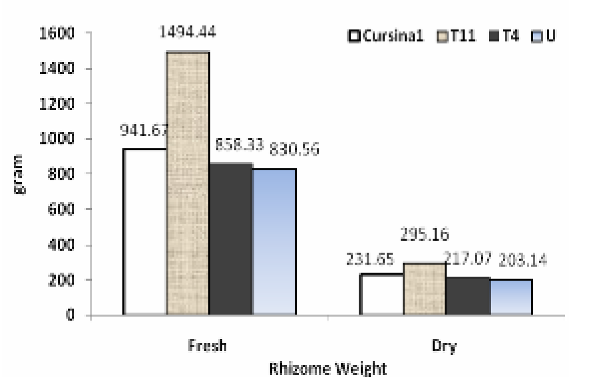

Figure **4**. Effect of four temulawak accessions on rhizome fresh and dry weight

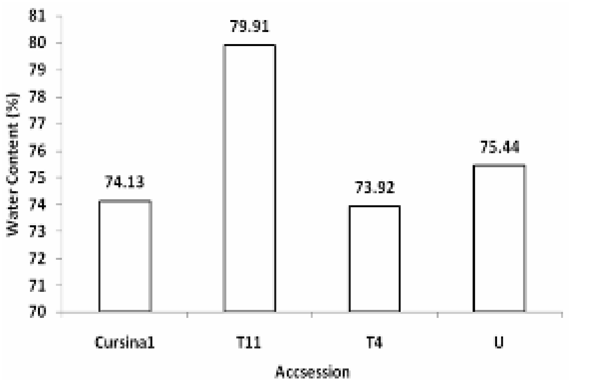

Figure **5**. Effect of four temulawak accessions on water content

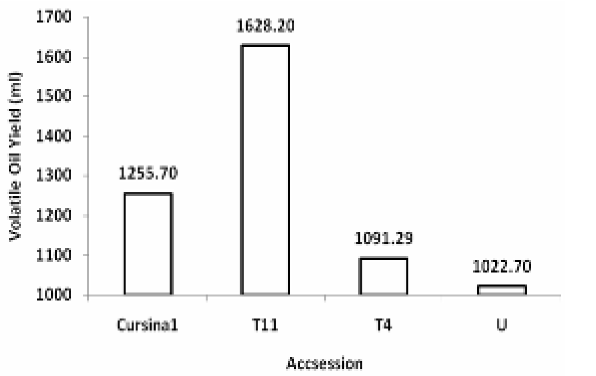

Figure **6**. Effect of four temulawak accessions on volatileoil yield

Rhizome water content of temulawak was approximately 75% (LP Unpad 1985). In this experiment, the water content was 71-79% (Figure 3). High water content might produced from heavy rain during plantation time. Harvesting time affected volatile oil content, rhizome fresh weight, rhizome water content and rhizome rendement (Table 1). Volatile oil content and rhizome water content was decreasing with the increasing of harvesting time. However, the rendement showed opposite trend.

The highest volatile oil content was at 7 months (5.88%, Figure 2). Temulawak volatile oil content was 3-12% (Sidik 2008). Rhizome fresh weight was highest at 8 months (1206.3 g/plant) then decreasing significantly at 9 months (839.6 g/plant) (Figure 2).

At 9 months, the fresh weight was lower than 7 and 8 months, meanwhile the dry weight tend to be higher in T11 although other accessions showed different responses. This trend happened because the rihizome water content was highest at 7 months while the rendement was highest at 9 months (Figure 2). At 7 months, photosynthate translocation for rhizome formation might be lower than 9 months old plant which resulted in low dry weight. Harvesting time, temulawak accessions and their interaction were not affected xanthorrhizol content and xanthorrhizol yield.

CONCLUSIONS

Interaction between harvesting time and temulawak accessions affected rhizome dry weight. The highest dry weight showed by accessions T11 at 9 months after planting.

Harvesting time affected volatile oil content, rhizome fresh weight, rhizome water content and rhizome rendement. Volatile oil content and rhizome water content was decreasing with the increasing of harvesting time. The highest rhizome fresh weight was at 8 months.

Accessions showed different responds in volatile oil yield, rhizome fresh weight, rhizome water content and rhizome rendemen. Accession T11 produced the highest volatile oil yield, rhizome fresh weight, rhizome dry weight and rhizome water content.

Harvesting time, temulawak accessions and their interaction were not affected xanthorrhizol content and xanthorrhizol yield.

REFERENCES

[LP Unpad] Lembaga Penelitan Universitas Padjadjaran. 1985. Rumusan Simposium Nasional Temulawak. *Prosiding Simposium Nasional Temulawak;* Bandung, 17-18 September 1985. Lembaga Penelitian Universitas Padjadjaran. p 234-238.

Agusta A, Chairul. 1996. Analisis komponen kimia minyak atsiri dari rimpang temulawak (*Curcuma xanthorrhiza* Roxb.). *Prosiding Simposium Penelitian Bahan Obat Alami VIII;* Bogor, 24-25 Nov 1994. Perhipba & Balittro. p 643-647.

Choi M, Kim S, Cheng W, Hwang J, Park K. 2004. Xanthorrhizol, a natural sesquiterpenoid from *Curcuma xanthorrhiza*, has an anti-metastatic potential in experimental mouse lung metastasis model. *Biochem Biophys Res Comm* 326:1 abstract. http://www.sciencedirect.com/ science*?* [1 Sep 2008].

Ghulamahdi M, Djauhari E, Nurcholis W. 2008. Temulawak (*Curcuma xanthorrhiza* Roxb.) under organic farming system and its relationship with bioactive content: a case study in Semarang district. In: *The First International Symposium on Temulawak* (*Curcuma xanthorrhiza* Roxb.); Bogor, 27-29 Mei 2008. Bogor: Biofarmaka IPB. p 372-374.

Gomez KA, Gomez AA. 1995. Prosedur Statistik untuk Penelitian Pertanian. UI-Press. Jakarta.

ISBN No. 978-979-25-1209-0

Hwang J, Rukayadi Y, Lee S, Cheng W, Park K. 2008. Industrial potential of *Curcuma xanthorrhiza* as antimicrobial and antiinflamatory agents. In: *The First International Symposium on Temulawak* (*Curcuma xanthorrhiza* Roxb.); Bogor, 27-29 Mei 2008. Bogor: Biofarmaka IPB. p 17-26.

Khaerana, Ghulamahdi M, Purwakusumah ED. 2008. Pengaruh Cekaman Kekeringan dan Umur Panen Terhadap Pertumbuhan dan Kandungan Xanthorrhizol Temulawak (*Curcuma xanthorrhiza* roxb.). Bul. Agron. 36 (3): 241 – 247.

Kim J *et al.* 2008. Antibacterial characteristics of *Curcuma xanthorrhiza* extract on *Streptococcus* mutans biofilm. *J Microbiol* 46 (2): 228-232. abstract.

ISBN No. 978-979-25-1209-0