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# Effect of solvents on [6]-Gingerol content of ginger rhizome and alligator pepper seed

**Y. O. Usman[1], S. E. Abechi[2], O. O. Benedict[1], O. Victor[1], U. U. Udiba[1], N. O. Ukwuije[1] and S. E. Anyahara[1]**

[1]*National Research Institute for Chemical Technology, Zaria, Kaduna*
[2]*Ahmadu Bello University, Zaria, Kaduna*

## ABSTRACT

*The effect of four extracting solvents [acetone, methanol, aqueous methanol (methanol: water 1:1) and water on [6]-gingerol content in two different spices- Ginger Rhizome (Zingiber officinale) and Alligator pepper seed (Aframomum melegueta) were investigated. The extracts, were analyzed with the Gas Chromatography-Mass Spectrometer (GCMS) QP-2010, Shimadzu Analytical Instrument. In both spices studied, the acetone extracts shows highest content 6-Gingerol (7.39%w/w and 7.32%w/w for Ginger and Alligator pepper respectively). The water extract has the lowest content of 6-Gingerol (4.58%w/w and 2.86%w/w for Ginger and Alligator pepper respectively). In all cases, Ginger rhizome gave the highest 6-Gingerol content.*

**Keywords:** Ginger Rhizome, Alligator pepper seed, 6-Gingerol, Solvent Extraction effect, GCMS,

## INTRODUCTION

Recovery of antioxidant compounds from plant materials is typically accomplished through different extraction techniques taking into account their chemistry and uneven distribution in the plant matrix. For instance, soluble phenolics are present in higher concentrations in the outer tissues (epidermal and sub-epidermal layers) of fruits and grains than in the inner tissues (mesocarp and pulp) [1]. Solvent extraction is most frequently used technique for isolation of plant polyphenol compounds (6-gingerol). However, the extract yields/concentration of the plant materials are strongly dependent on the nature of extracting solvent, due to presence of different polyphenolic compounds of varied chemical characteristics and polarities that may or may not be soluble in a particular solvent. Polar solvents are frequently employed for the recovery of polyphenols from a plant matrix. The most suitable of these solvents are (hot or cold) aqueous mixtures containing ethanol, methanol, acetone, and ethyl acetate. [2].

Alligator pepper seed (Aframomum melegueta) and Ginger rhizome (Zingiber officinale) both in the family of Zingiberaceae are renowned for their multiple medicinal, pesticidal, insecticidal and antimicrobial uses. Traditionally the seeds of Aframomum melegueta (Alligator pepper) are chewed to cure dysentery, and diarrhea [3]. The essential oil from Aframomum melegueta has exhibited activity against gram positive and gram negative bacterial as well as candida albicans. The oleoresin contains volatile oil, which is rich in sesquiterpene hydrocarbons humulene, ά- and –β caryophyllene (together 83%) and their oxides (together 9%) [4]. In the acetone extract of Aframomum from Ghana, the following hydroxyarylalkanones were found ; 1- (4-hydroxy-3-methoxyphenyl) –

decan-3-one (called (6)-paradole), 1-(4-hydroxy-3-methoxyphenyl)-3-hendecan-3-one (called (7)-paradole) and 1-(4-hydroxy-3-methoxyphenyl)-3-deca-4-ene-3-one (called (6)-Shoagole) in approximately equal parts [5].

In addition to the above medicinal purposes, the Ancient Hawaiian medicine recommends the use of Zingiber officinale primarily to treat motion sickness, and inflammation related ailments [6,7,8,9].

Ginger also contains volatile oil rich, pungent principles (gingerols and shoagole); as well as Zingerone. Ginger oil contains as its major components the sesquiterpene hydrocarbons and alcohols, and aldehydes (e.g phellandrene, camphene, linalool etc) methylheptenone and gingerol; and others [10].

However, the active compound of interest in both Aframomum and Zingiber officinale for this study is the hydroxarylalkanone such as 6-gingerole{5-hydroxy-(6)-paradole} 6-Gingerol has been structurally described as 5-hydroxy-3-methoxypheny-3-decanone with molecular weight 294.38 [11]. It is the major phenol and most important of the pungent principle which is extracted from the rhizome of Zingiber officinale and seed of Alligator pepper (Aframomum Meleguetta). It is believed that the pungent principles from Alligator pepper as related to that of ginger are thermally labile and two degradation pathways have been identified-.[A] Retrol-aldol condensation to zingerone and the appropriate aldehyde and [B] Dehydration to shogaols [12]. These are indications that 6-gingerol is sensitive to certain processing conditions [13].

It is important to establish appropriate means to evaluate and quantify effective polyphenolic principles of medicinally or economically viable plant materials. The present study therefore was conducted with the main objective of investigating the most effective solvent for extracting potent phenolic compounds (6-gingerol) and comparing the content of [6]-Gingerol in both spices investigated.

## MATERIALS AND METHODS

### Sample Collection

The ginger and alligator pepper samples were obtained from the local market in Kaduna and Abia state. The experiments were carried out at both National Research Institute for Chemical Technology, Zaria, Kaduna and Ahmadu Bello University, Zaria Kaduna.

### Sample Preparation and Extraction

Each of the dried samples was pulverized by using a mortar and pestle. Approximately 1g of each pulverized sample was weighed and placed in a 50ml volumetric flask separately with acetone, methanol, distilled water, and 1:1 water-methanol mixture as extracting solvents. The solvents were allowed to percolate the materials which were soaked in it for two days before collecting the extract. The extracts were filtered to prevent column blockage and then concentrated under vacuum by air suction, using laboratory Rotavapour [type 349/2 (Corning) with Stuart water bath | RE300B|] [14]. The concentrated extracts were treated as crude ginger and alligator pepper oleoresin extracts. The spectra and quantification of the crude oleoresins was made using the GCMS.

### Preparation of Standard and Instrumentation

The standard [6]-gingerol used was obtained from Ebiochem (China). A stock standard of 2.0mg/ml was prepared by accurately weighing 20mg (±0.01mg) of [6]-gingerol into 10ml volumetric flask dissolved in 7.0ml of methanol and diluted to mark.

The stock standard was diluted serially to create a minimum of a four point standard curve. Standard dilutions of the stock are 2.5:10, 1:10, and 0.5:10 using methanol. By making a single injection of the standard preparations, a plot of standard peak areas versus standard concentrations was created with the origin ignored [14].

GC-MS analyses were carried out by using a Shimadzu (Japan) GCMS-QP2010 gas chromatography mass spectrometer with electron impact ionization mode. With a RESTEK USA $RT_X$-5MS (30m × 0.25mmid × 0.25µm film thickness) column, operating conditions for GC were as follows: helium (99.999%) was used as carrier gas at a constant flow rate of 1.58ml/min; injection temperature was 250°C and interface temperature was 250°C and split ratio 1:0. Temperature programming was: 80°C, 2min; 80-200°C, 9°C/min for 4min; 200-280°C, 10°C/min for 5min. The mass spectra analyses were performed at 70ev and an ion source temperature of 200°C.

## RESULTS AND DISCUSSION

[6]-gingerol is found to be soluble in most organic solvents, but the extraction efficiency varies with different solvents as shown in Table 1. The percentatage of [6]-Gingerol in Ginger rhizome had a higher 6-Gingerol content of 4.58% w/w in the water extract while Alligator pepper seed had a lower percentage of 2.86% w/w. The same is the case for a 1:1 methanol:water extract which ranges between 5.15% w/w to 3.79% w/w 6-Gingerol content in Ginger rhizome and Alligator pepper seed respectively. In the water extract for both spices there is a marked significance difference in the gingerol component, so also is the 1:1methanol:water extract. The higher values observed in the 1:1 methanol:water extract is attributed to the polarity index of methanol and water which are 6.6 and 9 respectively.

**Table 1. [6]-Gingerol content of the Ginger and Alligator pepper analyzed**

| Extraction solvent | Ginger | | Alligator pepper | |
|---|---|---|---|---|
| | Mg/g | %w/w | Mg/g | %w/w |
| Acetone | 73.35 | 7.39 | 73.20 | 7.32 |
| Methanol | 56.85 | 5.69 | 71.70 | 7.17 |
| 1:1Methanol:Water | 51.45 | 5.15 | 37.90 | 3.79 |
| Water | 45.75 | 4.58 | 28.60 | 2.86 |

From Table 1, the ginger rhizome (Zinbiber officinale) shows the highest [6]-gingerol content as compared with that of the Alligator pepper seed (Aframomum melegueta) studied. Based on the extraction solvent used, acetone with a polarity index of 5.4 prove to be more efficient since it gave the highest concentration level of 7.39% w/w and 7.32%w/w for ginger rhizome and Alligator pepper seed respectively.

In general, it was observed that [6]-gingerol content is slightly higher in ginger rhizome than in Alligator pepper seed. Figure 4, summarised the concentrations variation of [6]-Gingerol in both spices as a function of various extraction solvents. Figure 1 shows the Chromatogram and mass spectrum for 2.0mg/ml Standard [6]-Gingerol, figure 2 shows the Chromatogram, Mass Spectrum & Calibration Curve of 6- Gingerol in Alligator pepper (acetone extract) APA and figure 3 shows the Chromatogram, Mass Spectrum & Calibration Curve of 6- Gingerol in Ginger(acetone extract) GGA.

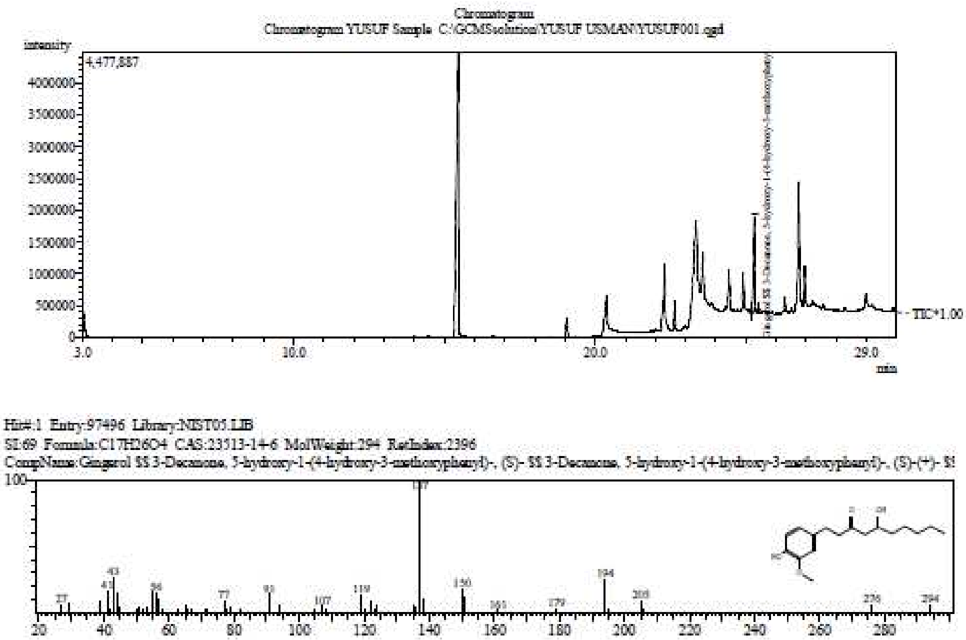


**Figure 1. Chromatogram and mass spectrum for 2.0mg/ml Standard [6]-Gingerol**

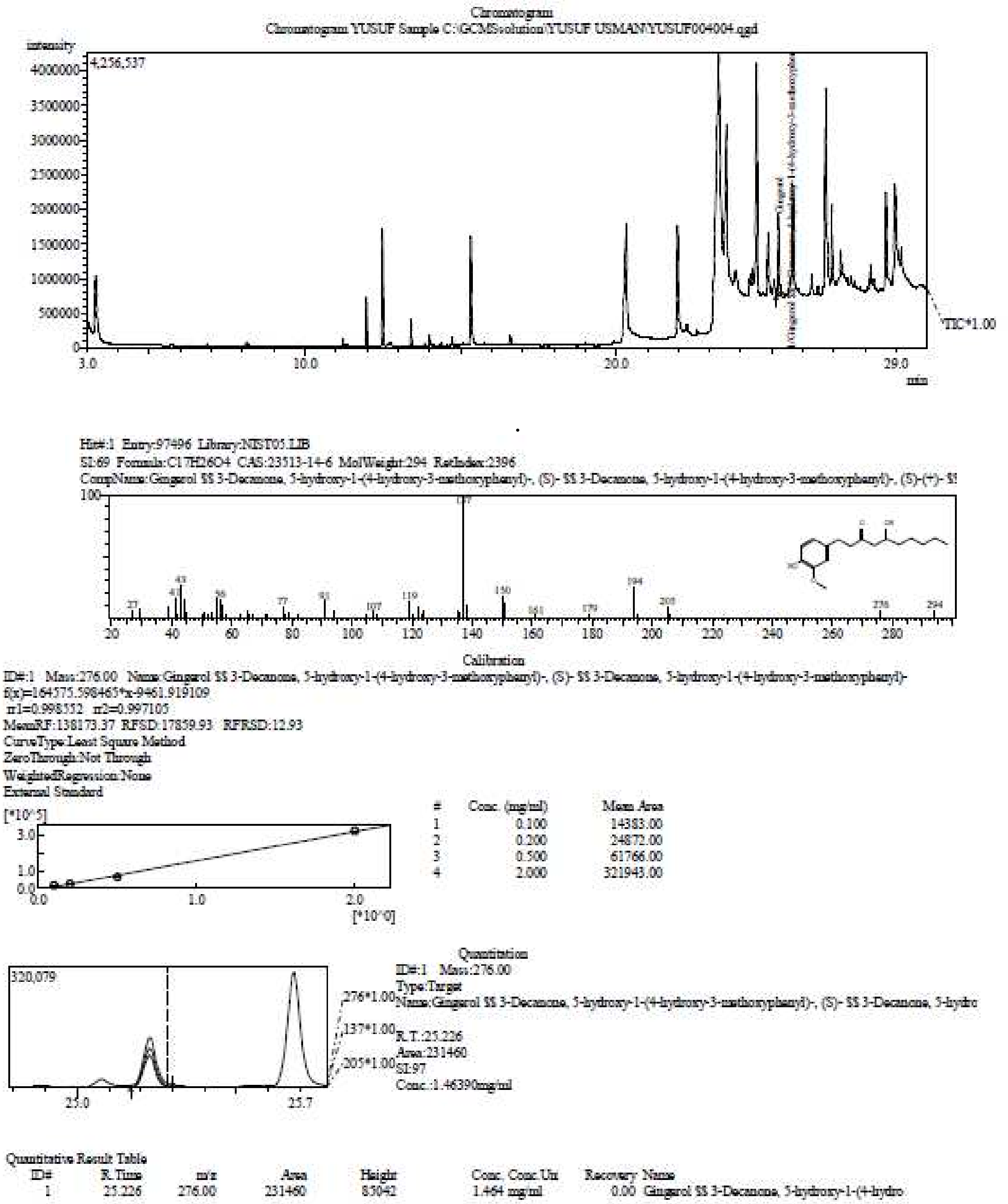


**Figure 2. Chromatogram, Mass Spectrum & Calibration Curve of 6- Gingerol in Alligator pepper (acetone extract) APA**

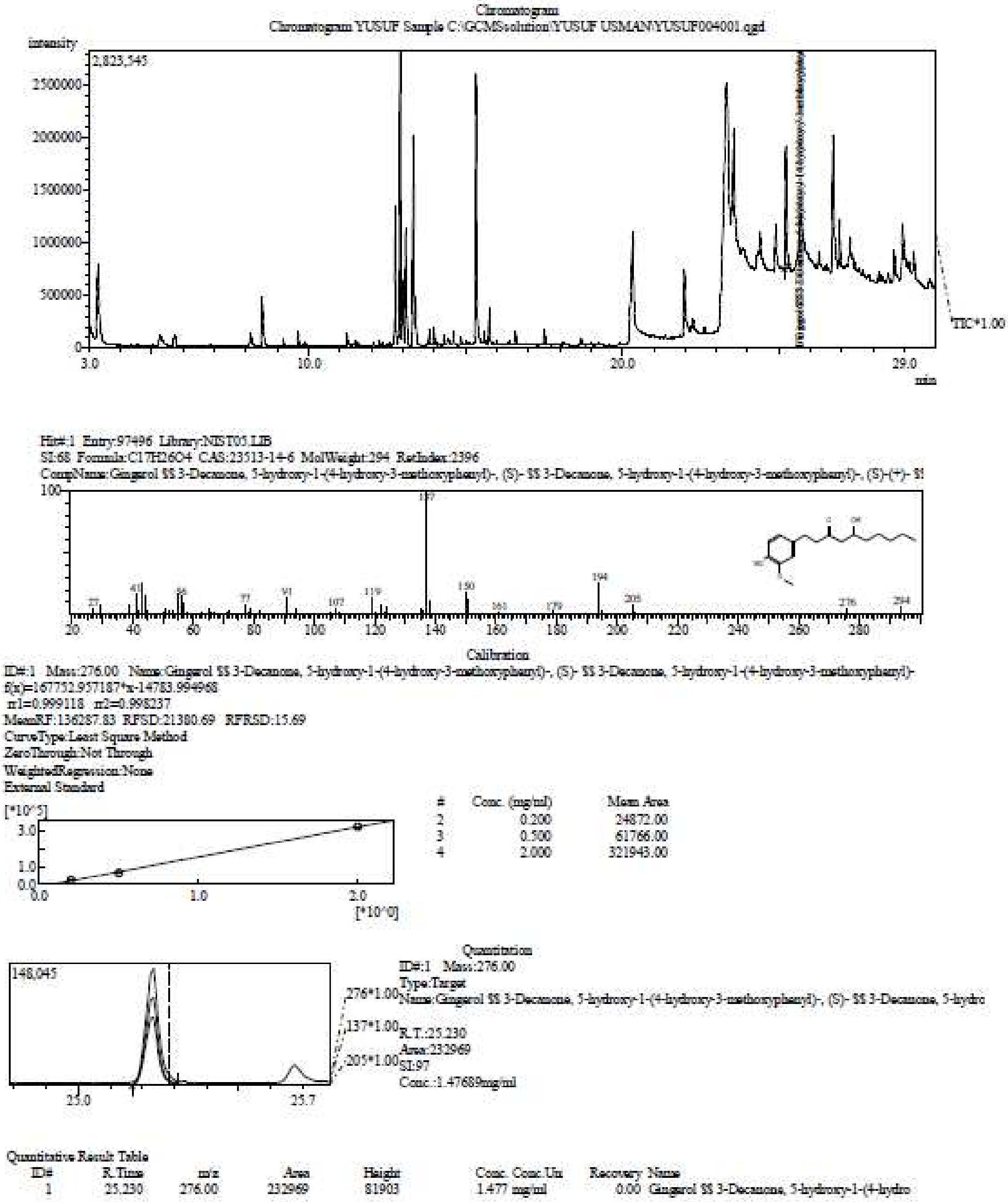


**Figure 3. Chromatogram, Mass Spectrum & Calibration Curve of 6- Gingerol in Ginger(acetone extract) GGA**

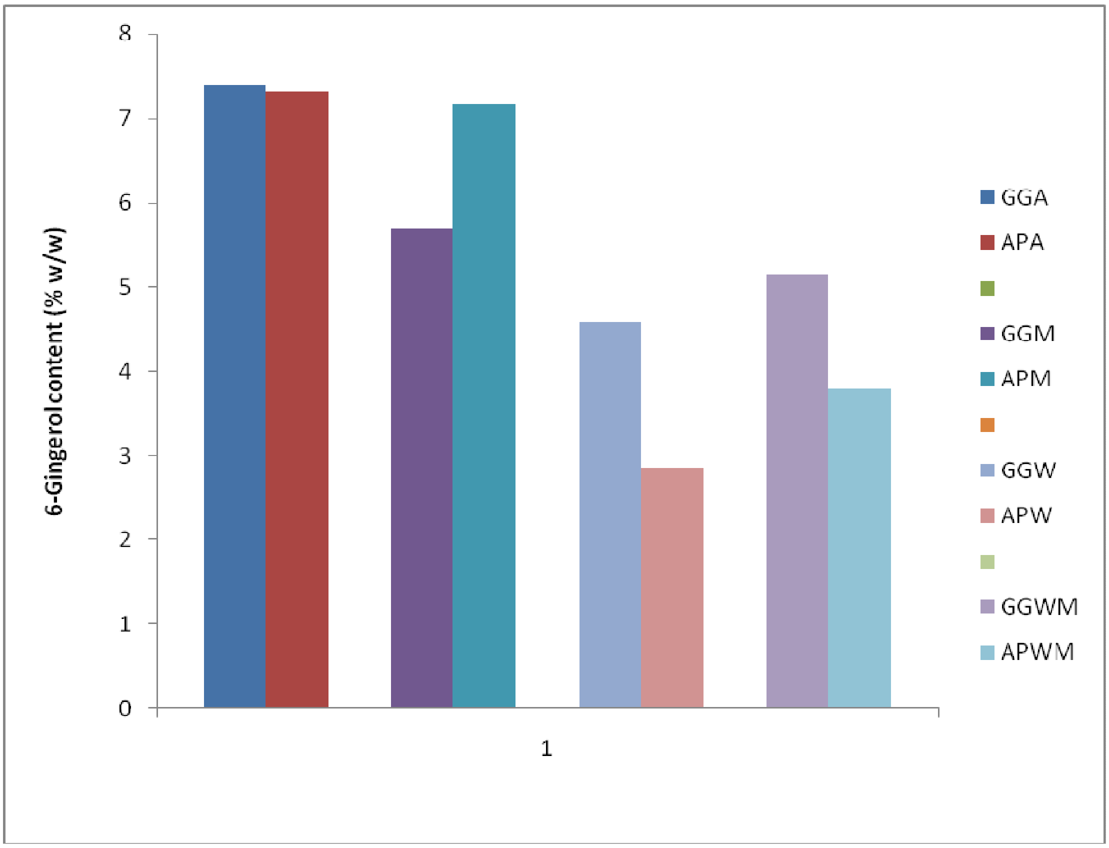


**Figure 4. show 6-Gingerol content in Ginger & Alligator Pepper extracted with various solvents**
*GGA= Ginger (acetone extract), APA = Alligator pepper (acetone extract),; GGM= Ginger (methanol extract), APM= Alligator pepper (methanol extract); GGW= Ginger (water extract), APW= Alligator pepper (water extract); GGWM= Ginger (water:methanol extract) APWM= Alligator pepper (water:methanol extract)*

## CONCLUSION

Ginger and Alligator pepper are potentially very effective phytomedicine in treating a wide variety of illnesses. Efficient extraction of potentially and practically beneficial compounds from ginger and Alligator pepper is an important step in understanding and efficient use of its medicinal properties.

It was found that the oleoresin extracts from ginger rhizome and alligator pepper seed via different extraction solvent followed by GC-MS analysis yield 6-Gingerol content at different level in both spices depending on the solvent used. Based on the extraction solvent used, acetone extract gave the highest concentration level of 7.39% w/w for ginger rhizome as compared to 7.32% w/w for alligator pepper seed. Thus the lower range values were observed for the water extract ranging from 4.58% w/w for ginger rhizome and 2.86% w/w for alligator pepper seed.

From these report findings, it can be concluded that the concentration of 6-Gingerol in Ginger rhizome is higher than that of Alligator pepper seed and acetone extract gave a better extraction efficiency in both spices.

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