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Pharmacologic vitreolysis of floaters by 2-month pineapple juice supplement- an animal study

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Abstract: Introduction: This is a new method of pharmacologic vitreolysis from the nature fruit supplement that was a developed technique in the world. **Methods**: Our study was completed between April 2020 and June 2020. A total of 36 SD rats with 36 eyes were enrolled in our studies and received ocular retinal check- up. Every SD rat was fed with various doses of pineapple according to our protocol. Experiment 1, 12 mice were classified into Group 1 (group with one symptomatic vitreous opacity (SVO)) and Group 2 (group with multiple SVOs) which was all fed with 20 mg pineapple mixed with diluted water (10 CC) every day. In Experiment 2, other 24 eyes from SD rats with SVOs were all randomly divided into four groups including the placebo group; low pineapple juice group (LPG) (10 mg/day); middle pineapple group (MPG) (20 mg/day); and high pineapple group (HPG) (40 mg/day), respectively. At final, we analyzed the change in SVOs in all experiments. Besides, we examined the pathology of kidneys and livers from sacrificed rats after 2 months. **Results**: In experiment 1, 6 SD rats with one SVO decreased to 3 subjects ($P < 0.05$) and the rate of success was 50.0 % (3/6) after 2 months feeding. The 6 cases with multiple SVOs decreased to 2 rats (27.5%) after 2-month therapy ($P < 0.05$). The disappear rate was 72.5% in the multiple-SVOs group. In experiment 2 (N=24), the final disappear rate in the 4 groups with placebo, LPG, MPG, and HPG were 100%, 33.3%, 50% and 66.3%, respectively. In other words, the disappear rate was 33.3%, 50% and 66.3% of SVOs in LGP, MGP, and HGP after 2 months of the pineapple juice supplements ($P < 0.05$). Hence, the results showed that the unified effects treating SVOs in a dose-dependent manner; the higher the dose, the greater the SVO reduction. Besides, there were no abnormal finding in kidneys and livers in all SD rats after feeding with 2 months. Furthermore we suggested that the mechanisms of dissolving and absorbing SVOs may be due to the proteinase and hydrolysis and antioxidant activities that may clear the compromised vitreous opacity and scavenge the free radicals in the vitreous. **Conclusion**: We demonstrated that pineapple intake may excise SVOs and eliminate intraocular hemorrhage by cleaving the collagen fibrils and the cellular debris that may induce any types of ocular floaters.
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Keywords: symptomatic vitreous opacity; ocular floater; bromelain; pineapple.

1. Introduction

The vitreous is a transparent and highly hydrated (98.5% water) extracellular matrix (ECM) attached to the retina in human. The vitreous is primarily maintained by collagen fibrils including types II, V/VX and IX. Few collagen I and III are also involved. Moreover, this structure is preserved by a network of long, thin collagen fibrils about 15 nm in diameter〔1〕. Herein, some collagen fibrils may be organized into small bundles and interconnections between the bundles that allow an extended network and provide the vitreous strength due to the gel statute. Over time, for example, it was found that vitreous collagen I, II, III, and IV would decrease, resulting in the surface exposure of a “sticky” pattern of collagens. These conditions caused the collagen fibrils to aggregate and liquefy; this was accompanied by vitreous shrinkage and clumping, which made shadows on the retina. Subsequently, collagen fibrils were stabilized by intermolecular and intramolecular cross-links with hyaluronic acid (HA), which belongs to glycosaminoglycan and fills the space between the collagen fibrils. In general, HA attracts water and inflates the gel. HA should compromise the chondroitin sulfate and heparan sulphate, the important components of ECM. Moreover, CS provides the resistance to external force and HS induce the cell adhesion to ECM by fibronectin and laminin.

HA is a major component of ECM in vitreous. HA-binding proteoglycans were associated with excellent visco-elastic properties. The shape of HA

shows enough flexibility and forms various helical configurations which maintain the biodegradable and biocompatible activities〔3〕. It is soluble in water and is an essential component in solutions of high viscosity, which supply lubrication, adhesion, and elasticity to the adjunct tissues. Thus, the scaffolds of vitreous are called HA. The C- and N-terminal pro-peptides from HA are easily removed and degraded by proteinase〔2〕. Moreover, vitreous liquefaction, flecks of protein, vitreous debris, inflammatory balls, blood particles and torn retina contributed to the symptomatic vitreous opacities (SVOs). If left untreated, they could cause impairment of vision and permanent visual loss in later stage〔3〕. Vitreous liquefaction and SVOs happened, the shapes of shadows on the retina revealed ocular floaters〔4〕. The disordered HA and collagen fibrils were cut and SVOs disappear〔5〕. The symptoms are the perception of lines, circles, dots, flies, cobwebs and clouds when looking at white paper, or blue sky. These perceived images can move as eyes move ways. The individuals attempt to look directly at them, and the vitreous floaters would seem to move away at once.

In human, the vitreous progressively liquefies and pockets of liquid form in the gel. This age-related redistribution of the fibrillar components of vitreous leaves the spaces between the collagen cables filled with liquid. The collagen fibrils of the core may form the thick cables, instead of the random orientation of fine fibrils in the gel network. In fact, liquefaction is caused by the aggregation of collagen fibrils which induces re-distribution of the fibrils and other parts of vitreous developed a lack of fibrils converting into liquid compartments. The speed at which vitreous changes happen depends on the patients' ages, environmental factors, exposure to UV or blue light, oxidative stress, and HA-collagen interaction〔6,7〕. If PVD gently progresses, the symptoms are mild. However, if the forces of separation are strong, PVD could tear the retina or blood vessels. It was found that in 14% of cases, traction forces sometimes caused retinal tears or breaks and retinal detachment (RD) which may impact the human vision〔8〕.

The relationship between floaters and PVD is very close〔9〕. Moreover, PVD is a natural change that occurs in adulthood. The etiologies of PVD were associated with risk factors including age, oxidation, and increased proteolytic activity〔10〕. Photo-activity such as UV and blue light also induce vitreous liquefaction. Recently, free radicals would increase the insoluble fibrils and HA. Moreover, PVD changed the properties of collagens fibrils and induced the cross-links of molecules. Hence, scavenging free radicals is benefit for SVOs. The incidence of SVO is estimated as 3.1/100000 per year and the peak incidence occurs between 45 and 65 years old of age in human〔11〕. Although in most patients, the symptoms were minimal, they still resulted in significant impairment in vision-related quality of life. Recently, SVOs seemed to be the cause of an increased awareness of visual and psychological disabilities which were affected by SVOs. Moreover, patients who are professionally successful and intelligent notice floaters more often and have a stronger desire to receive treating. Roth et al. identified a correlation between subjective distresses caused by SVOs〔12〕. Furthermore, Mason et al. concluded that patients with SVOs were frustrated when failed to remove〔11〕. Only patients with a more active lifestyle and who got rid of the symptoms go to the retinal clinics to pursue surgery regardless of the profession and condition.

In our clinics, there are various methods for treating SVOs. First, observation is the first and most reasonable choice for clinical treatment of ocular floaters. Only 11% of subjects' eyes should show spontaneous dissociation over a mean of 5 years and some cases with vitreo-macular traction (VMT) syndrome could progress to full- thickness macular holes (FTMHs) that impact vision. For patients, observation is indicated if the condition of this disease is simple and stable and does not justify the risks of surgery or VMT resolves spontaneously. However, there are several disadvantages of observation. With only observation, some 64% of victim's eyes lost at least 2 Snellen lines after several years. This is the reason why the physicians suggested that adhering to observation only for SVOs is controversial at times and therefore adopted more aggressive therapies for floaters. YAG laser vitreolysis is used in treating SVOs located at the middle and posterior vitreous near the retina for which the shock will break the opacities. Some documents claimed highly variable success rates, ranging from 0% to 100%〔13〕. However, even with varying degrees of success, the associated complications are increased numbers of floaters, RD, cataract, scotoma, elevated intraocular pressure (IOP), glaucoma, and posterior capsule defects. Besides, PPV was approved as the effective approach in completely clearing the SVOs. The subjects who experienced persistent or severe SVOs scheduled to undergo PPV. Equally, vitrectomy had many disadvantages, with only one-third of eyes gaining 2 or more lines by Snellen chart〔14〕. Sometimes, PPV was associated with the patients' economic burden and various postoperative complications such as endophthalmitis and glaucoma. Besides, RD would occur in 2.4% and 92% of eyes developed into cataract within 3 years after vitrectomy. Comparing severe side effects, the patients should hesitate to adapt the more invasive approach.

Bromelain is extracted from Collagen types II and V/XI form the core of the rope-like fibrils, whereas type IX collagens are regularly distributed along the fibril surfaces〔15〕. In our past study, we demonstrated that consumption of pineapple would decrease ocular floaters. Furthermore, we found that bromelain, papain and ficin, which were all from crude pineapple, cut and cleared ocular floaters and opacities (not published yet). According to the analysis, the stems and fruits of pineapples contain various proteases and collagenase, which are responsible for debridement and dissolve the over-growth of tissues including several proteins and polysaccharide. These are the components of degraded HA〔16〕. Doneva et al. used the exogenous enzymes such as bromelain, papain and ficin to break down some low-weight connective tissue. For example, the proteinase from bromelain would cleave both myofibrillar and collagen protein〔17〕. In fact, various fruit enzymes have long been used to treat human disease. However, the medical applications for ocular diseases have so far been rare. In our research, we tried to determine the effectiveness of bromelain by intake and analyze their ability to degrade SVOs, which aggregated the collagen fibrils. If SVOs diminished and disappeared, our pineapple therapy should be considered as a good regimen with rapid, simple and safe characteristics.

2. Materials and Methods

This prospective study included 36 consecutive eyes of 36 SD rats diagnosed as ocular SVOs in Southern Taiwan from April to December in 2020. All study of total course was 2 month. The mice (N=36) in all 2 experiments were between 7 and 8 weeks of age (the mean age: 7.6 age of years). They were maintained standard laboratory condition (a 12 hour light/dark cycle and a temperature of 22.2 ±2°C). Stand chow (contained > of 25% crude protein, > 4.5% crude fat, < 12% water and < 9% ash; Fwusow Industry CO. Ltd) and sterilized water were available ad libitum. Furthermore, we recorded the age, gender and the numbers of SVOs for all cases. The definition of "SVOs" was ocular vitreous floaters severe enough to cause symptoms and the images could be found by a series of ocular examinations. The objective findings were gained from direct or indirect ophthalmology. Retinal images were considered the same regardless of shapes, and any numbers of SVOs greater than one was considered as multiple SVOs. Before and after our treatment, we analyzed the numbers of images as the outcomes. No SD rats received any ocular surgery in laboratory within 1 year. Ocular diseases such as the posterior uveitis, endophthalmitis were also excluded because of the complicated courses. Cases of the intraocular tumors could be also excluded within 1 year. Retinal images were considered as the same ones regardless of shapes, and any SVOs greater than one was considered as multiple SVOs. Before and during the treatment, we analyzed the changeable numbers of images as the outcomes. All rats were excluded if the signs from examinations were not remarkable when they subjectively suffered from vitreous floaters. In addition, the visible images of SVOs could be doubly checked by the indirect ophthalmoscope in each month. After 2 months, the SD rats were sacrificed and the pathology of kidney and liver from the testing animals.

We checked the body weight of every rat in each month and fed the mice in our two experiments according to the designed protocols. In experiment 1 (N=12), all mice (one SVO and > one SVO) with vitreous floater were given with pineapple juice (20 mg/day) (Middle dose). Moreover, in experiment 2, 24 rats with SVOs were randomly divided into 4 groups (different treatment doses): placebo group (no feeding) (6 cases), low pineapple group (LPG) (6 cases), middle pineapple group (MPG) (6 cases) and high pineapple group (HPG) (6 cases). The end-point of study was 2 months for the whole experiment. When the image in the one SVO group disappeared to a zero image, this case was considered "success". We recorded the numbers of SVOs during and after the 2-month remedy (Figure 1). They were analyzed for the effectiveness of pineapple juice with the use of SAS 9.0 (SAS Inst., Cary, NC, USA). The difference was compared by paired t-test in experiment 1. We further compared the results between placebo, LPG, MPG, and HPG at baseline and during the whole 2-months by Scheffee test in experiment 2. In addition, P value < 0.05 was considered as " significantly different". The numbers of ocular floaters, and body weight gain were recorded every month.

3. Results and Discussion

The mean body weight was 250 g at baseline and it got to mean 650 g after 2 months of feeding. In experiment 1, 6 SD rats with one SVO decreased to 3 subjects ($P < 0.05$) and the rate of success was 50.0 % (3/6) after 2 months. The 6 cases with multiple SVOs decreased to 2 rats (27.5%) after 2-month therapy ($P < 0.05$). The disappear rate was 72.5% in the multiple-SVOs group (Table 1). In experiment 2, the final disappear rate in the 4 groups with placebo, LPG, MPG, and HPG were 98%, 33.3%, 50% and 66.3%, respectively. In other words, the disappear rate was 33.3%, 50% and 66.3% of SVOs in LGP, MGP, and HGP after 2 months of the pineapple juice supplements (MPG and HPG, $P< 0.05$) (Table 2). Hence, the result also showed the dose-dependent correlation between at the higher dose of enzyme intake and the higher disappeared rates. The higher

doses of our capsules have the stronger hydrolysis ability for degrading SVOs. However, the ocular opacity in the placebo group did not vanish remarkably without the fruit enzymes ($P > 0.05$). During ocular examinations, we found that SVOs had absorbed in the "successful" cases. The extract of pineapple should enhance the functions of hydrolysis and lysis. Therefore, we suggested that taking bromelain from pineapple was good for dissolving and absorbing vitreous opacities easily.

An ocular floater or opacity is the result of opaque fragments floating in the vitreous. Many patients experienced floaters initially, but generally the symptoms were not troublesome for daily life. Clinics found that SVOs could be associated with floaters, intraocular blood clots, and overgrowth of ECM. Patients with more than 10 SVOs or a cloud in front of vision had a high risk of developing retinal tears. The7 shadow of SVOs on the retina was determined by the diameter of the vitreous opacity, its distance from the retina and the overall distance between the pupillary plane and the retina. If SVOs were removed and absorbed by any method, the ocular floaters would diminish or disappear〔6〕. When SVOs aggregate to fuse together, they may be fixed or mobile especially after the development of posterior vitreous detachment (PVD)〔7〕.

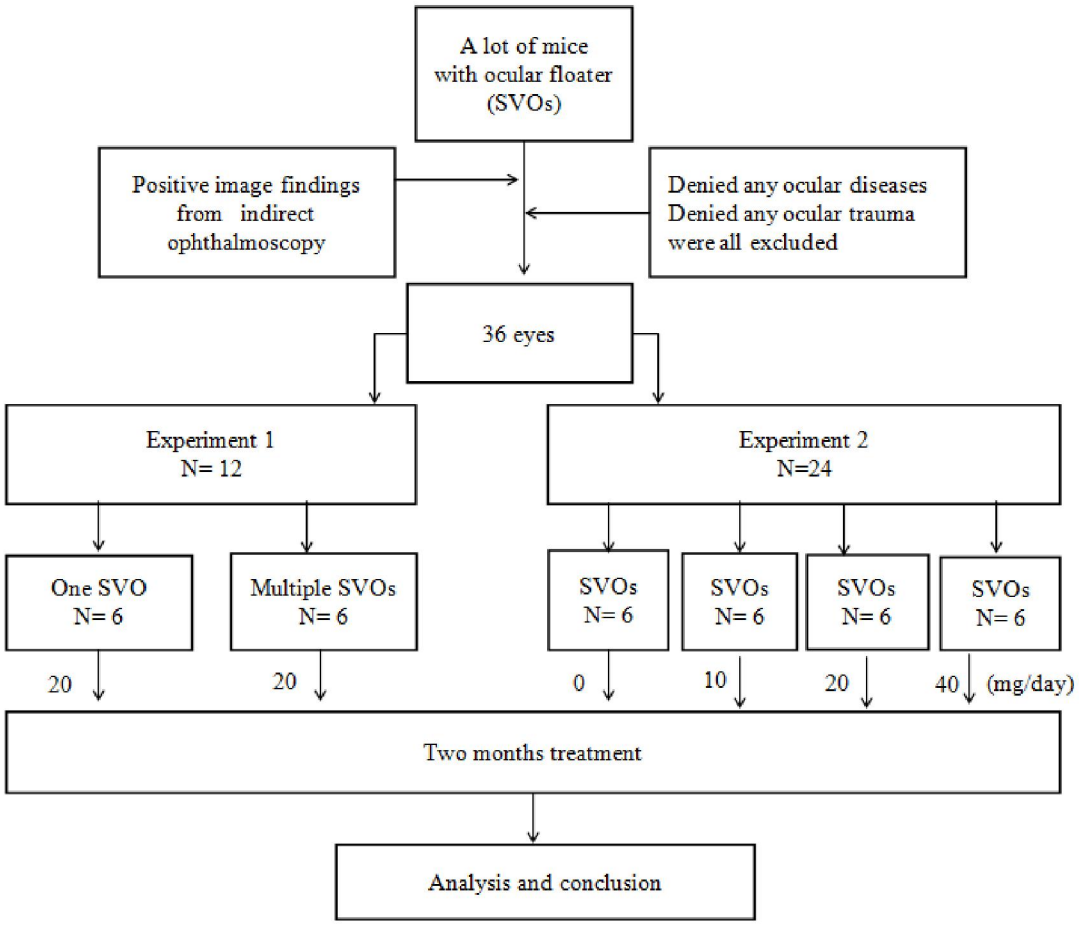

Fig. 1. Approach of the study.

In SVOs, larger members of cobwebs-like shapes may indicate the occurrence of a serious condition such as vitreous hemorrhage (VH) from diabetic retinopathy or trauma. If the subjects experience dark images, they should see the retinal surgeon immediately. Moreover, ocular dark floaters alone or combined with flashes of light may be the precursor to retinal detachment (RD) or VH〔8〕. A study demonstrated that patients with isolated PVD, VH and ocular floaters at initial presentation needed to be rescheduled for a follow-up visit. Furthermore, the patients were instructed to return if the numbers of SVOs increases.

Table 1: The changes in floaters before and after pineapple supplement over a 2-month period

Numbers of SOVs	Baseline	1st month	2nd month	P Value
One	6	6	3*(50%)	<0.05
Multiple	6	5	2*(27.5%)	<0.05

N= 12 eyes

1. Multiple floaters means a patient with at least 2 ocular floaters in the visual field.
2. After treatment, multiple floaters may completely or incompletely disappear. Therefore, the multiple floaters would change to 1 or 0 floaters.
3. All 12 rats were feeding with 20mg pineapple in each day.

Table 2: The changes in the ocular floaters before and after the pineapple juice supplement over a 2-month period

The weight of pineapple juice each day	Before	1st month	2n month	*P* value
Placebo	6	6	6 (100%)	> 0.05
10 mg	6	5	4* (66.7%)	<0.05
20 mg	6	5	3* (50%)	<0.05
40 mg	6	4	2* (33.7 %)	<0.05

N=24

1. Group 1 (placebo group): N= 12 eyes, no pineapple was taken.
   Group 2 (LPG): N=6: all mice were fed with 10 mg pineapple every day.
   Group 3 (MPG): N=6: all mice were fed with 20 mg pineapple every day.
   Group 4 (HPG): N=6: all mice were fed with 40 mg pineapple every day.

*2. We compared the results at the baseline and after 2 months by pair-t test. A p value less than 0.05, showed a significant difference.

The pathology showed that the kidneys and livers from every SD rat were all normal. We could conclude that the pineapple was no damage to the animals for long-term taking (Figure 2).

Our study showed that most of the ocular floaters did not impact the vision; and the numbers of floaters sometimes increased with age. Although the symptoms were minimal, they also caused significant impairment in vision-related quality of life for some victims〔21〕. The SOVs would happen suddenly and bother the subjects. However, patients might adapt to the vitreous opacities over the 3-month period. SVOs can be associated with PVD with or without retinal breaks.

The ocular floaters may bother the daily life of the victims. For example, Vanova et al. demonstrated that the floaters could impact the quality of life with respect to vision-dependent tasks and found more than two-thirds of the patients had moderate to extreme difficulty in reading small print and even in driving at night〔22〕. Chronic floaters may be just as problematic for some individuals as other well-established ocular conditions that are viewed as having more impact on visual functioning, such as cataract or macular membrane. Additionally, Wagle et al. concluded that degenerative SVOs had a negative impact on patient's health-related life〔21〕. The cohort studied by this group on average was willing to accept a 7% risk of blindness to eliminate SVOs, and this risk was comparable to the associated risk of treating diabetic retinopathy and age-related macular degeneration. Obviously, the safe use of the new methods for treating SVOs is important.

The reason for the sudden onsets of ocular floaters in patients 40 years or older has been related to PVD in 95% of cases in human. The common complications from PVD are retinal tears, retinal hemorrhage, optic-disc hemorrhage, RD as well as SOVs. Furthermore, severe PVD may dramatically induce retinal tear, VH, and RD〔22,23〕. PVD itself is not a serious problem, although it leads to local interference with the passage of light and causes the symptoms referred to as floaters. In clinics, PVD is the most common cause of acute -onset floaters. It has been found that if the eyes are exposed to various factors including visible light, ultraviolet light, ionizing radiation, environmental toxins and endoplasmic reticulum stress (ER stress), the unstable reactive oxygen species (ROS) characterized by unpaired electrons would be produced〔23〕. Therefore, oxidative stress could result in the formation of PVD, which degrades the combination of HA and collagen fibrils. Moreover, PVD would be accompanied by a sharp increase in floaters, but after

the acute phase, the symptoms may settle down, partly owing to adaptation. In most cases, the initial symptoms are transient as the patients learn to 'live with them'. However, some cases may continue to have quite troublesome floaters even with good visual acuity.

In clinics, current treatments for ocular floaters and SVOs include observation, Nd: YAG laser vitreolysis, PPV and newly developing pharmacologic vitreolysis. At first, close and regular observation by experienced ophthalmologists was indicated when the victims experiencing limited vision were relatively young or extremely old. Patients with few floaters and SVOs should receive close follow-up. The treatment success rate varies and cannot be predicted. However, most patients desire more aggressive treatments for resolution of visual symptoms and psychological problems.

Nd: YAG laser, which vaporizes opacities, is attractive due to its effectiveness and ease in treating the middle or posterior floaters. The laser would be used for the lysis of fibers, rhexis of aggregates, and displacement out of the visual axis.

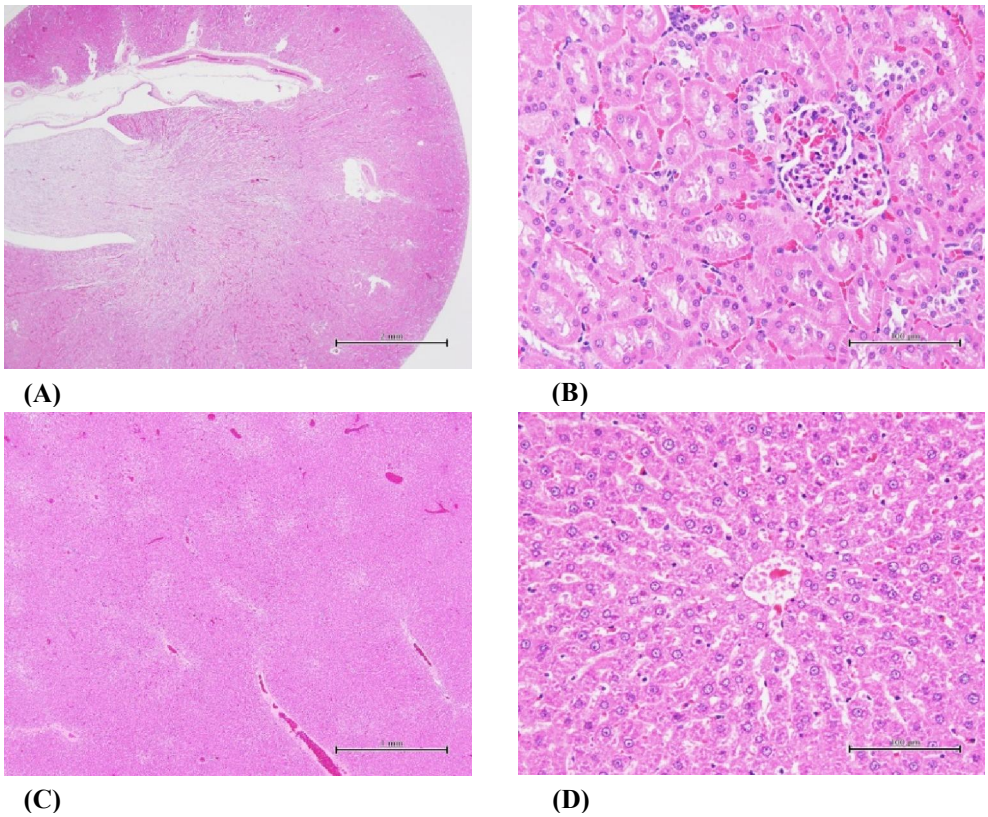

Fig 2: Histopathological findings of the kidneys and liver in rats after pineapple supplement for 2 months. No significant change of the kidneys (A & B) (H & E stain; 20x) and liver (C and D) (H & E stain; 40 x) were detected.

Now, it has been widely for sever vitreous strands, and break larger opacities into small particles to be ignored. For therapy, we always use the sufficient energy (3 to 4 mJ) to treat opacity, as well as a sufficient number of laser pulses (150 to 200 pulses) to treat SVOs. Typically, only opacities relatively far from the retina are treated; thus, the therapy may be appropriate for only some patients. Unfortunately, the laser has the potential risks of cataracts, elevated IOP, posterior capsule defects, retinal tear or hemorrhage and RD〔24〕. However, the amorphous floaters in the mid- to posterior vitreous are difficult to visualize and treat by laser sometimes. As of 2011, PPV may be a better option for more diffuse vitreous opacities, fibril strands, VMT and FTMHs and could remove the damaged vitreous, thereby clearing the floaters in the visual axis. Schulz-Key and his co-workers showed that the indications for PPV for SVO are persistent ocular floaters, visually disabling effects, affected work, and the need to blink or turn the head try to see clearly〔25〕. Today, 25- or 27-gauge PPV for removing the vitreous through a smaller incision has now become the main and safer procedure. The complications of PPV are cataract, glaucoma, endophthalmitis, macular pucker, cystoid macular edema, RD and even loss of vision which limit the

broad indication of PPV. Although the results showed that 85% of participants were satisfied by surgery, most of the patients preferred food supplements to avoid the higher number of side effects from surgery and desired the safe and more effective conservative treatment to be developed through future research.

Except for observation, laser and PPV, the pharmacologic vitreolysis developed recently, intravitreal ocriplasmin (microplasmin) (Jetrea; Thrombogenics USA, Alcon) injection is a recombinant and truncated form of human 27 kilodalton serine protease plasmin, a non- surgical option and alternative treatment instead of PPV for VTM that induces smaller fragments of plasminic enzyme 〔 26,27 〕. Furthermore, ocriplasmin is enzymatically able to degrade cleaved collagens, fibronectin, laminin, over growth tissues, extra-ECM, useless vitreous fibrils and the protein scaffold between the vitreo-retinal space. For patients with SOVs, a single intravitreal injection of 0.125 mg should be used to treat the subjects by cutting vitreous strands and opacity. It was reported that for patients with vision worse than 20/50, 25.1% of their BCVA should gain ≥ 2-line of the Snellen chart and few SVOs would resolve at day 28 after injection. Current options showed that ocular floaters, SVOs, and proliferative tissues could be dissolved by the proteolytic and collagenotic functions of ocriplasmin. Moreover, the mechanism of ocriplasmin for treating SVOs and enhance the traction release successfully and achieved an improvement of 26.5% at day 28 〔 28 〕. Ocular floaters and SVOs are the consequence of vitreous attachment with disturbance of the retina, which would be dissolved by ocriplasmin. It was even reported that patients with SVOs who received an ocriplasmin injection had a response rate that reached about 11%. In addition, dose - and time - dependent cleavage was achieved by ocriplasmin between posterior vitreous cortex and ILM. However, the adverse events included acute reduction in vision, metamorphopsia, visual field defect, ERG changes, dyschromatopia, retinal tear or detachment, lens subluxation and phadodonesis. Intravitreal injection also has several complications such as endophthalmitis, glaucoma, cataract and even RD〔26〕. Furthermore, it is relatively expensive at about $2,000 per dose, and repeated injections combined with intraocular surgery required to treating SVOs 〔27〕.

There are at least three mechanisms for treating SVOs and floaters in bromelain from pineapple supplement. Firstly, metallo -proteinase (MMPs) plays an important role in mediated message and proteolysis. Second, these three fruit enzymes have the ability to dissolve and cleave the abnormal ECM and vitreous opacities. Finally, these enzymes also support the antioxidant protection in oxidase stress from vitreous changes. In human body, the MMPs degraded the components of the complex ECM. It was also found that MMP-2 would cleave collagen types I, II and III, while MMP-9 would cut collagen types I, III and IV. Therefore, MMPs could clear SVOs in patients and decrease ocular floaters 〔 29 〕. The endogenous MMPs are even beneficial for pharmacologic vitreolysis and some vitreo-retinal diseases such as VMT and macular holes. Recently, it was revealed that different levels of MMP-2 and MMP-9 were found. Furthermore, endothelial progenitor cells also play an important role mediated by MMPs for matrix absorbing and remodeling. The MMPs, which were found in the vitreous of patients in the proliferative phase, could degrade the ECM, growth factors and compromised collagens. For example, bromelain has the MMP-2 which could own the proteolytic function 〔30〕.

There are many uses for pineapple and its derived ingredients. For example, bromelain is one of the most popular fruit proteases that is extracted from the pineapple stem and fruit. Recently, bromelain was introduced and originally applied to any protease from the plant family Bromeliaceae〔31,32〕. The cystein proteases, including bromelain, is the most abundant in Bromeliaeceae and belong to a free sulfhydryl group of a cysteine amino acid side chain that is required for function. It is reported that the medical advantages of bromelain may be due to its proteolytic and hydrolytic activities. Bromelain is used as a dietary supplement to treat nasal swelling, osteoarthritis, cancer, asthma, gout, chronic sinusitis, tendonitis, and burn. Furthermore, bromelain can control hypertension and cardiovascular disease such as peripheral artery disease and stroke〔33〕. It also inhibits the ability of platelets to aggregate and reduces blood clot formation. Bromelain has hydrolytic, anti-fibrinolytic, anti-inflammatory, and anti-thrombotic properties. The stem is the most common source because of its usable quantities. However, care should be taken because of its side effects of allergy and hyperglycemia.

4. Conclusions

Recently there has been an increase in awareness of the visual disability caused by vitreous floaters or opacities 〔 48 〕. The onset of floaters is often secondary to SVOs and the possible complications. Besides, acute onset of floaters and even PVD would develop into retinal break within 6 weeks. Hence, early diagnosis and treatment for vitreous floaters and SVOs is very important. In this animal research, we demonstrated that pineapple supplement significantly dissolved and absorbed the vitreous opacities. In other

word, the extract of pineapple may clear the SVOs and vitreous strands effectively. Moreover, free radicals could scavenge by some fruit proteases. Furthermore, we found the regular fruit enzymes intake may result in a dramatic disappear rates of SVOs with fewer side effects. Finally, we believed the taking pineapple is suitable for patients with SVOs and ocular floaters. Besides, the mechanisms of pharmacologic vitreolysis such as hydrolysis and antioxidant function were also suggested.

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